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DISCOVERY

A Monthly Popular Journal of Knowledge

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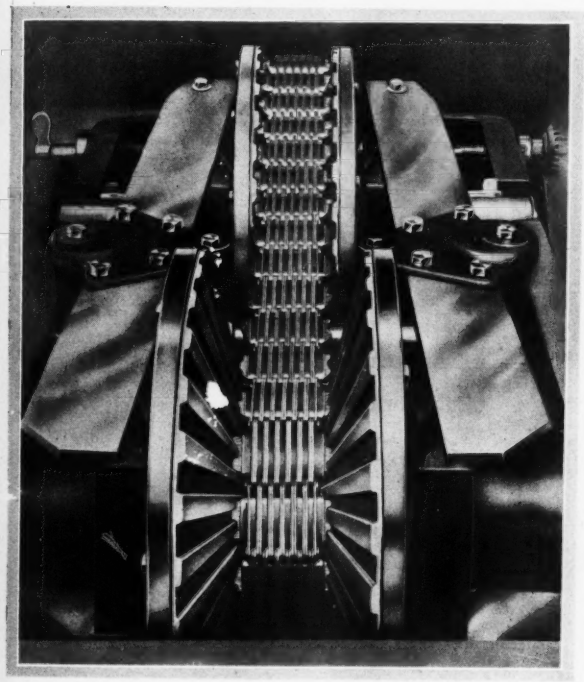

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Editorial Notes.

DURING the past two weeks an interesting public controversy has been taking place over a newly-published book, "The Great Delusion," from which we reproduce certain passages on another page this month. In this work an anonymous author issues a sensational challenge to accepted views on aircraft and their future, basing his case on a study of the many documents on flight that have appeared since the war. If his conclusions were merely the outcome of speculative opinion, the controversy arising out of them would resolve itself into a discussion of academic rather than practical interest. As Mr. Hungerford Pollen points out, however, in the extracts reproduced from his preface, "the strange thing is that, despite the rudeness of the onslaught, no new discoveries seem to have been made." The evidence advanced by "Neon" has been amassed from such universally available authorities as Hansard, the daily papers, and the scientific press; and as he has done little more than quote the laws and collect the facts, the case does not primarily rest on argumentative ingenuity. Apart, therefore, from its public significance—as Sir Samuel Hoare recently stated: "We must get men and women in all walks of life thinking of air problems"—the new book demands close study from a purely scientific standpoint.

* * * * *

In order to survey the present position of civil aviation, we shall publish next month the first of several articles in which existing and projected services will be discussed and illustrated with maps; this feature being one of the special contributions to appear in our May "Travel Number." The publicity given to the more sensational flights tends to overshadow the progress actually achieved in exploring the possibilities of air transport. Since the new year, for instance, a flight has been completed from France to Madagascar via the African west coast and central continent, returning by way of the Great Lakes, the basin of the Nile, and the Mediterranean. The flight was made by Lieut. Bernard in a Liore and Olivier flying-boat fitted with a Bristol "Jupiter" air-cooled engine, and was the first of the kind undertaken by the French naval air arm. Its object was to test the value of the seaplane as a means of communication between the French African colonies and to prospect for new routes. The caravan routes and the waterways afford certain conveniences for transport of heavy merchandise, but as there are no good motor roads and railways will take long to establish, there are obvious advantages in the aeroplane for carrying passengers, mails, and light freight. The total length of the outward journey was more than 9,000 miles, and occupied about six weeks, a month being taken on the return. As much as 800 miles was flown in a single day, frequently over dense forest where forced landing would have meant disaster, and it is a tribute to British engineering that throughout the flight no engine repair of any sort was necessary, nor was a single spare part used.

* * *

It has now been announced that investigations undertaken by the Air Ministry research staff into the cause of detonation in engines using liquid fuel have led to a conclusion that may have an important bearing on attempts to solve the troublesome "knocking" problem. For some time, especially in America and Germany, scientists have been developing "anti-knock" reagents with more or less success, but the fundamental cause has remained to some extent obscure. It is now established that

in an engine using liquid fuel this trouble is of chemical origin, being due to the formation of organic peroxide compounds, which become concentrated on the nuclear drops of the gas mixture during compression and ignite the drops simultaneously when the detonation temperature of the peroxide is reached. This discovery is regarded by those engaged on fuel problems as of great importance; and as illustrating the persistence of research, it is of interest to recall that the earliest reference to a possible connexion between peroxide formation and detonation is contained in a paper presented by Sir C. Brodie to the Chemical Society as long ago as 1864.

* * * * *

There have lately been discussions in the press on food preservation, accompanied by the outbreaks of doubt that are periodically cast on the purity of food and on the methods of those responsible for its preparation and handling. It was therefore an opinion to be welcomed from no less an authority than Mr. Richards Bolton, in his presidential address to the Society of Public Analysts last month, that the food of the country was never in a purer state than it is at the present time. While giving his blessing in the same speech to the new Preservatives Regulations, Mr. Bolton warned us not to be led astray by alarming articles magnifying a few cases of adulteration, thus causing the public to think that we live in the year 1820 when Accum wrote "Death in the Pot." He was, however, careful to add a compliment to the free press which by its habit of continually deprecating our actions spurs us on to better things. In this case it is interesting to note that the development of other methods for attaining similar results, that always accompanies restriction of any kind, has taken the form of a considerable fillip to the manufacture of refrigerators, which have been applied to new purposes since the passing of the Act.

* * * * *

That the work of public analysts is not, however, confined to foodstuffs, is illustrated by an interesting note on an alleged use of marking ink in ancient Egypt which has reached us from Mr. Ainsworth Mitchell, editor to the Society. Last month he contributed a letter to these pages correcting the statements of a leading newspaper on researches at Dorton Spa. His present investigation concerns a passage in Sir Ernest Budge's well-known book on "The Mummy," which on page 137 states it to be "worthy of note that Egyptian ladies marked their linen with indelible ink," and refers readers to "the winding sheet of Tchehutí-Sat." This fabric is preserved in the British Museum, and is a long rolled-up linen sheet with a fringe at the end, the name, in a brown pigment, running horizontally across the material just above the fringe. No reasons being given by the author for the conclusion that indelible ink was used for the purpose, Mr. Mitchell applied a series of micro-chemical tests to the pigment, with the collaboration of Dr. Alexander Scott, director of the research laboratory of the Museum, and as a result discovered that this was probably an organic colouring matter, attached to the material in the form of a paint—a principle used in stencilling modern fabrics. "It is only in the sense that writing which has come down to us through the ages is relatively permanent," Mr. Mitchell concludes, "that this pigment can be described as 'indelible,' and it has nothing in common with the indelible marking inks of to-day, the pigment of which is formed within the fibres of the material after the application of the ink."

* * * * *

No apology is needed for quoting again in these columns from the excellent articles by Mr. Leonard Wooley appearing at intervals in *The Times*, in which he reports the results of continued excavation at Ur in Mesopotamia. The most recent accounts deal with work to the end of January, and announce the discovery of a great entrance gateway, which gives an entirely fresh aspect to Nebuchadnezzar's Temenos—the precincts of his temple. The gateway was unearthed at a point where previous investigation had failed to trace the line of his enclosing wall, and it not only completes the plan but throws the great courtyard into true perspective, practically confirming the view that this was itself the main temple of the Moon God. The excavation of another building that may have been a royal audience-chamber put up by King Sin-idinnam shortly before 2000 B.C., revealed the remarkable feature that it had undoubtedly had an arched and vaulted roof, which until recently would have been judged wholly impossible at such an early date. But the finding of arched doorways in private houses of the same period, and the fact that contemporary brick tombs were sometimes barrel-vaulted, justify a restoration of this building which according to Mr. Wooley upsets all the views that have been held about the history of architecture in the East. These new facts follow closely upon the discovery for the first time of private houses of the period, reported in our February issue. Excavation has also been continued on an ancient cemetery, which now appears to date from between 3500 and 3200 B.C., and has yielded rich information on this early period. A photograph of the Ur site appears on page 127 of this issue.

Pre-Sumerian Man : New Evidence from Arabia.

By L. H. Dudley Buxton, M.A., F.S.A.

On the return journey to Jerusalem from Kish, Mesopotamia, where the author recently conducted excavations with Professor Langdon, a number of flints were discovered. Examination of these has now yielded new evidence which suggests that the north Arabian desert was inhabited as early as 20,000 B.C., *long before the rise of the great Sumerian civilization.*

In a previous article I described a visit to the excavations at Kish in Mesopotamia, and told something of our journey from Jerusalem to Baghdad.* Our way out in a modern caravan was a dash against time, a means to an end, not an end in itself. Our return journey was one of the most interesting and fruitful times I have ever spent, and even now it seems hard to think that we packed so much into four days.

On our way out we had found some stone implements which, while undoubtedly the work of early man, were few and indefinite ; we wanted to find more. Fortunately for ourselves, on the return journey the Air Vice-Marshal gave us permission to go out into the desert with the armoured-car patrol, and we practised archaeology under extremely strange conditions. Our party included Henry Field and myself, archaeologists and civilians, and a detachment of the R.A.F. with armoured cars. I think that we were first of all regarded as extremely mad ; out East, however, the afflicted of Allah are always regarded with compassion, and before very long the detachment were as afflicted as ourselves—but that is a story I will tell in its proper place.

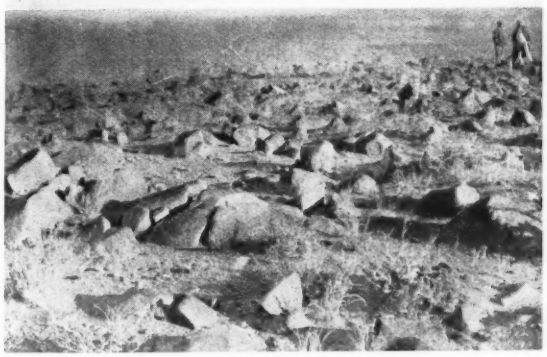

Fig. 1.
LAVA BED IN THE WESTERN DESERT.
The finding of implements in such arid surroundings affords evidence of the different climatic conditions prevailing in Arabia in prehistoric times.

We did a short journey the first day along the Euphrates to a place called Ramadi, which is a "desert port" in the same sense that the camel has been called, *ad nauseam*, "the ship of the desert." All along the Euphrates there are a series of towns from which the caravans start out on their hazardous journey across to the Mediterranean ; west of them there is no permanent habitation until the borders of Moab are reached. For ourselves—for the armoured cars were coming back the same way—there was one place where water could be obtained, and only one, after we had left Ramadi.

We started off at dawn and it soon began to rain—not desert weather perhaps, but it does rain even there—and we were miserable till lunch time, when it cleared up, and we halted in rolling country, to make our first find, a flint implement, but not of any type which could be recognized. We halted for the night nearly two hundred miles from Ramadi, at Rutba Wells, our one watering place.

I was the only person in the party who spoke Arabic, and that not well, so it fell to my duty to accept the hospitality of the desert police, while Field hunted for flints and only found one, and the detachment worked at the cars. I sat cross-legged on a sheepskin in a black Arab tent, drank tea and coffee and smoked, and got several useful pieces of information. I asked whether the Arabs ever used flint to-day as knives, and showed them some I had found on the way out. They were very scornful. Those were of no use ; the Bedouins sometimes used flints to make fire, but not useless pieces like that. I had one or two flakes that look very modern, but the people who use the strike-a-lights repudiated them. This was so far satisfactory.

Then I asked about old ruins, were there any in the desert ? They told me there were some at Nazr, a few miles away, and that there was a well there too, but dried up. Beyond that they knew of nothing. So we talked and smoked and drank coffee. All this sounds very prosaic in the telling, but in an Arab tent with a lantern hanging from the pole, a brazier

* "A visit to the Excavations at Kish, Mesopotamia"—*Discovery*, April, 1926.

*

of camel thorn giving an intermittent red glow, and a gathering of swarthy-faced desert police, hung around with scimitars and other lethal weapons, it was really a very pleasant way of spending an evening, although so far our quest had been unsuccessful.

Next morning we soon came to Nazr. This place was of particular interest because it was to shed further light on a problem met with on our expedition to Kish. I explained in my earlier article how we had there excavated a site in the desert south of Baghdad called Jemdt-en-Nazr, and that I was of opinion that the name Nassar or Nazr was that of a local saint—the word actually means "saviour." The name is a common one in many parts of the Middle East, and we had, as a matter of fact, had a servant of that name at Kish. On the other hand, Professor Langdon was at first inclined to believe the name to be a survival of a vague memory of Nebuchadnezzar, in much the same way perhaps that in Cyprus, for instance, to-day it is perfectly certain that modern saints preserve a memory of forgotten ancient shrines. In this case the name would be an indication that there existed a city whose very site perhaps has been forgotten, but whose vague memory has lingered on for so many centuries.

Nazr was easy to find, as the desert police gave us clear instructions, but although we searched carefully we got no definite archaeological data. There were some vague stone ruins, a well now dry but beautifully preserved, the construction of which can be seen in Fig. 3; and that was all. There were no traces of the potsherds or bits of broken crocks which strew the ground in their thousands on any old city site, and had there formerly been any settled habitation on the spot even our short visit would have shown us at least some traces. But there was nothing, just a few stones, obviously the foundation of some post, possibly a *qsar* or guardhouse on the road and a well—nothing to indicate that many men had once lived and fought and died in this remote spot.

The name Nazr, then, at least in this instance, turned out to be unreliable as a guide to the finding of ancient Babylonian cities, and the Professor and I are now inclined to regard it as a name of a local saint whose origin, however, is as yet obscure.

We climbed into the cars again and went farther into the wilderness. Sixty miles from our starting-place in the morning we punctured—a fortunate chance, for while the detachment laboured with the huge tyres, Field and I ran round, eyes glued to the ground, and we began to find things. We each went out in opposite directions, although never more than a hundred yards or so from the cars. Every now and then I heard Field shout "got one," and he stooped down and picked up an implement. This unknown spot in the wilderness gave us some of the most definite information we obtained about Palaeolithic man. If anybody wants to go and find more—and there are plenty to be found—it is close to Landing Ground R. (see Fig. 2), which is marked on the air maps, and on the map the Royal Geographical Society has published of this area.

I did not realize the importance of my finds here until I went over them later, and they provided me with definite evidence of late Palaeolithic man of the period usually termed Aurignacian. (Fig. 5).

After the puncture had been mended, we had no more luck, although we stopped once or twice. We halted for lunch at a crashed aeroplane. The spot is known universally as Maitland's Monument, after the name of the man who crashed, though he was not killed. We searched here again very thoroughly

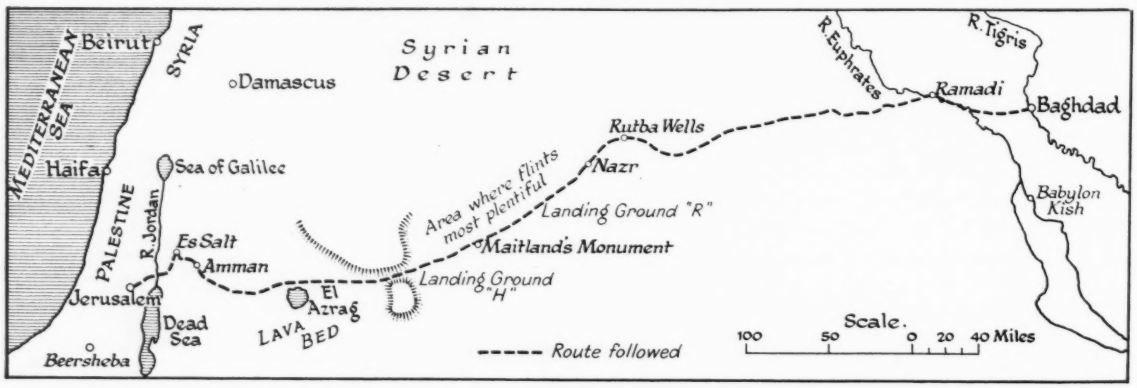

FIG. 2.
MAP OF THE AUTHOR'S JOURNEY, SHOWING PLACES WHERE THE FLINTS AND OTHER RELICS WERE DISCOVERED.

but found nothing, and stopped for the night about a hundred miles farther on, at a place nearly surrounded by low hills and enclosing a shallow desert lake. Here we had found implements on our way out, and we hoped for great things. It was getting dark when we pulled up, but we had a look round and found a few flakes.

That evening, after the cars had been nursed and put to bed and the day's work finished, the men made a fire of camel thorn and asked me to tell them something about Palaeolithic man. I have seldom had so keen an audience — there was a little circle seated on empty petrol drums, the firelight flickering on their faces, and outside the circle nothing but the wilderness. So I told them what little I could about the people who lived in that desert probably more than a hundred centuries ago. A man every now and then heaped more fuel on the fire from the pile they had gathered, and Field demonstrated on the implements that we had found. The lecture was not perhaps very highbrow, but it had great practical results. The rest of the time the men spent their scanty leisure looking around and found quite a big proportion of our specimens.

FIG. 3.
ANCIENT WELL PRESERVED AMONG RUINS AT NAZR.
The visit to Nazr shed further light on a problem connected with the meaning of this name, which is of frequent occurrence in the near East.

Then the men cast lots for turns at guard. On the desert patrol the officers take turn and turn about with the men under their command, and our host had the first watch. I suggested sharing it with him, so we inspected the camp and put out the fire lest we should be a mark to desert raiders. We walked round and round the cars, and talked softly of what the place must have been like when the makers of the implements lived there. Great changes have clearly taken place. The spot was at least a hundred miles from the nearest permanent water. There was a little pasture when we were there and some water in the desert pools, but in the summer the ground is parched and dried up. To live there without camels would be impossible, with them difficult, but the desert Bedu seem to survive on only camel's milk, and the camels are the nearest thing to perpetual motion in producing milk without much pasture that ever existed. But even the most hardy Bedouins could not live there permanently.

Yet we found definite evidence that man had, long ago, lived there and up on the high desert near landing-ground R. Further, there is no evidence at present that Palaeolithic man ever domesticated camels, though the history of that animal's association with man is not very well known. The problem seemed a difficult one, and my host was inclined to suggest that the stones were made by Bedouins, though he admitted that they were obviously very old, as the surface even of the worked parts was highly polished by the action of the wind blowing dust against it. Such polish takes a long time to acquire. However, the solution is fairly simple. In western Europe, where the Old Stone Age has been thoroughly studied, we know that during that period the climate was very different from what it is now, and that the ice-cap reached much farther south. Climatic conditions over the whole world must have been very different, and there is every probability that there was a good deal more rain in the north Arabian desert. It is unlikely that there was ever any heavily-forested region there, but a little more rain would serve to convert that poor steppe into quite habitable country, and make it possible even for primitive hunters to live there. After we had gained a little more experience, we found that worked flints were found principally in small hollows and little dry valleys, although this was by no means an invariable rule. It may well be that in the remote period, when man was living there, water flowed down the valley bottoms, and possibly there were even burbling streams.

FIG. 4.
MOUSTERIAN HAND AXE.
As explained in the text, this was probably the most important implement discovered.

So we talked under the stars, watching the horizon with our field-glasses at intervals, but we saw nothing and turned in when the end of our watch came. Next day as soon as breakfast was over Field and I started out. We were told not to go out of sight of the cars, and we put on revolvers to signal with if we saw anyone. I have never done archaeology before looking as if I were prepared to repel boarders or engage in other military feats of arms. We met with no adventures and made many finds, some obviously very early flints and others of later date. At the bottom of the hollow, near the Air Force landing-ground H, we found a large lake possibly a hundred acres in extent and nowhere more than a foot or so deep. Owing to some trick of Nature there were clearly two surfaces. On the one we found no evidence of man's handiwork. The lower surface, about a foot deeper, seems to have been exposed in ancient times, and here we found a large number of small flint tools. Luckily, in some places the upper surface had been removed by wind or other action, and the older floor was exposed. We wandered about for some time before we understood exactly what had happened, and we were disappointed that at first we found so little. Afterwards we knew where to look.

We returned to camp with full pockets and very sore heels, to find that after the cars had been cleaned and looked over, the detachment, instead of going to sleep—which as the sergeant said to me was "indicated"—had turned themselves into archaeologists and had searched for flints. What is more, they had found them, and flints of a later date than those we found at the bottom of the depression. I cannot say why at one time man had lived in one spot and later migrated to another higher up on the hillside, but at least in that place they did, possibly owing to a change in climatic conditions.

During the afternoon we met a tribe of wandering Bedouins on the move—a singularly Biblical occurrence, for while peace was literally on my lips (for that is the desert greeting) we made ourselves ready for battle, without fortunately having to do more than make a demonstration. We slept one more night with the armoured-cars, and got up at dawn to wait for the mail convoy which was going to take us on to Jerusalem. It was icy cold in the grey before the dawn, although so hot in the daytime, and the men called it "a short course in death," but a fire of camel thorn soon gave us hot tea and rabbit stew and we then felt better. The convoy came along and we said goodbye to our excellent hosts, who started on their five-hundred-mile journey back to garage after doing a little more patrolling to see that the King's peace was being kept. We had a few punctures and found implements at nearly every stop.

When we arrived in Jerusalem our pockets were bulging and Field's attaché case was overburdened, so until we reached home again we hardly knew what we really had found. A careful examination later, however, showed us that our finds belonged to the middle and later periods of the old Stone Age, probably the oldest dating from as early as 20,000 B.C. (Fig. 4). We also found a beautiful little laurel-leaved arrow-head belonging probably to the New Stone Age.

Conclusions.

Briefly the conclusions which can be drawn from the evidence collected are as follows. In the valley of the twin rivers only material which suggests a fairly advanced culture has been found, nothing primitive has come out of the mud of the Tigris and Euphrates. Here, on the divide between Mesopotamia and Palestine, we have definite traces of the existence of man in all likelihood very many hundred if not thousands of years before the rise of the great Sumerian

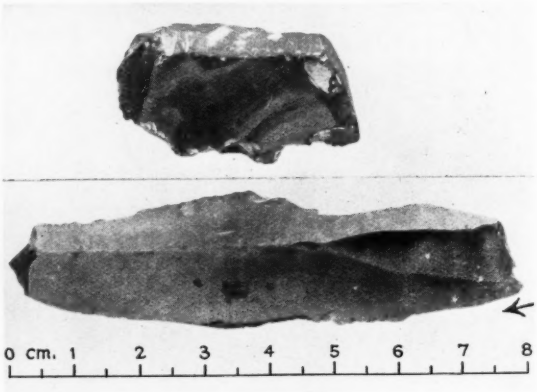

FIG. 5.
SCRAPER AND GRAVER OF LATE PALAEOLITHIC PERIOD.
The scraper (above) was found at landing-ground H (see map) and the graver in the lava bed, not far from where Fig. 1 was photographed. The arrow marked on the right below the graver indicates the surface with which the blow was struck.

civilization. We have evidence which suggests an entirely different climate and conditions (Fig. 1) from those which prevailed in Mesopotamia since the earliest times we can trace in that region. Although many of the implements were found far away in the desert, yet we found a few quite close to the River Euphrates. We searched carefully in Mesopotamia itself and found nothing very early, nothing before about 3500 B.C., a long time ago but only a short time compared with the immense period which must have elapsed since Mousterian man hunted on these wild uplands. My little arrow-head may possibly bridge the gap to a certain extent and indicate a race of more advanced hunters, but it is by itself uncertain evidence. The Sumerians were very accomplished agriculturists, using an elaborate system of irrigation. Such a system, although when learned from other more advanced peoples may be practised by comparatively primitive peoples, takes many years to build up. The Sumerians, however, were far from being primitive, they had behind them a long and elaborate but as yet unknown history.

These flints take us back into another world. We do not know, of course, what Mesopotamia was like, nor do we know what was the relationship between the valley people and the highlanders. The former may have already been quite advanced, but we have now definite evidence that there was a culture which definitely preceded the earliest Sumerian city known. There is a gap which is yet to be filled. We have primitive hunters on the plateau long before the dawn of history, away in the valley, at about half the distance between London and Edinburgh; we have possibly thousands of years later, when history begins, an advanced civilization. The evidence for a Babylonian culture on the plateau is, I have tried to show, doubtful.

One further point remains. Man is known to be conservative in his physique more than in his culture. It is a noteworthy fact that in ancient Kish and to-day among the modern Arabs there survives an ancient physical type, closely resembling a type living in western Europe in Aurignacian times. It is tempting to suggest that the ancient Kishites and their modern representatives are the actual descendents of the primitive pre-Sumerian hunters who were living in the North Arabian desert many years before that region became a desert.

The Problem of the Mystery Religions.

By the Rev. James Wall, M.A.,

Chaplain of Downing College, Cambridge.

Much research has lately been directed to the mystery religions, the ancient beliefs involving ritual in certain respects similar to that of the Christian faith which superseded them. The problem of how far the influence was mutual is here discussed from a non-partisan standpoint.

In the middle of the second century A.D., the Fathers of the Christian Church complained that the mysteries then current in the world around them were but imitations of their own rites inspired by demons. For centuries this explanation was accepted in silence, or at least no alternative suggestion was made. When of late the subject was taken up again the pendulum, not unnaturally, swung in the opposite direction, and the thesis was set up that Christianity was but a sheer imitation of the pagan mysteries. The subject has been the "live question" of recent years. Research, scholarship, and ingenuity have been lavished upon it and the time is not far distant when a final verdict may be given, even if it be one of "insufficient evidence." The publication of "St. Paul and the Mystery Religions" and "The Mystery Religions and Christianity"* have provided two excellent English works on the subject, and which one might venture to assert have at all events brought the last word within sight. Meanwhile, the question was dealt with in at least three papers at the Conference of Modern Churchmen held at Cambridge last autumn.

*See Bibliography at conclusion.

Mystery Defined.

What is a mystery? Even now it is difficult to say One of the chief demands upon those who had been initiated was a vow of secrecy. And so faithfully and unexceptionally have these vows been kept that we have no direct account in ancient literature, nor any intelligible disclosure. The fullest account we have is contained in Apuleius' novel, "The Golden Ass" (*c.* A.D. 160), wherein are described the public processions and so forth, but when he is heading for the interesting part he puts the reader off by recalling his vow. For our conclusions we are forced back upon a little fact—and that in its most lucid assertions from the pens of Christian critics who fervently

disapproved—and upon our own conjectures. That is why the subject is at once so interesting and so impossibly difficult.

However, this much at least is known of the mysteries: they were old-established and widespread, and existed and throve in one form or another, perhaps without much alteration, for nearly a thousand years. Even in Homer's time the Greek religion of Olympus was on its last legs. Its gods suffered from being unworthy of the name; they were amoral, at least, and any kind of mystic communion with them was impossible. The Greeks were a thinking race, and these gods at best could only inspire state cults. More earnest religious feeling demanded other gods; and by the middle of the first millennium B.C., the mystery worship of Dionysus had come down from Thrace and the hard-drinking North, to be fused in Greece with the cult of Orphism, which came up, probably a little later, from Crete and the South. Thenceforward and until well into the Christian era, mysteries were prevalent all over the Mediterranean basin; those of Sabazius and the Great Mother, Cybele, from Phrygia, of Isis and Serapis from Egypt, of the Baals from Syria and, to be developed more fully a little later, of Mithras from Persia.

Secret Societies.

They were all different, but the same in general content. They enjoined secrecy upon the members; they were for individuals, rather than for nations or classes; and they were syncretistic, and in no way jealous of each other. A man could join one or many, or he could join one instead of many; all the gods and goddesses were but the same deity masquerading under different forms, and that deity was the life-force, describe it as you will, which has found its most sublime expression in the Christian deity, Love. All the mysteries offered their adherents salvation, a personal salvation. How far it was effective in this life one would hesitate to say; but in death it was a salvation from the demons who guarded the various gates from this life to the next, and rigorously excluded all who lacked the sacred passwords only to be learnt in the mysteries; and in the world to come, they offered an eternity of bliss. Each mystery had its legend, given and intended as pure myth, in no way subject to the canons of historical criticism. Legends were of varying content, from tales of the god up to theories of the universe, especially of that portion of it traversed only after death. But all illustrated the death of the god and his rebirth, whether of Dionysus or Persephone or Attis or Mithras, all in sympathy with the successions of spring and autumn, or the rise and wane of sun or moon, and suggestive of death and revival.

Whatever sacred books and liturgies they had, there is no evidence that they were in any way comparable to the Jewish scriptures or Christian liturgies; and where other claims are made they are made entirely on extravagant conjecture.

Three Stages in Mystery.

There appear to have been three stages in the mystery: of initiation, of full membership rites, and of the culminating stage, at Eleusis of *Epopteia*, wherein the initiate was regarded as in some special way the *watcher* and *overseer* of the god, and made to receive ritual homage as the god's deputy. But such evidence as we have of the rites is so scanty, dark, and confused that it can only with the greatest uncertainty be orientated.

The rites all suggest a break with the past life, purification (how far ritual and how far morally implied is unknown) and communion with the god in a new life. The earliest Eleusinian rites included the following acts: on the first day the candidates for initiation were assembled, and those indicted who had "hands unclean" or who were "unintelligible of speech." On the next day, to the cry of "sea-wards mystics," the worshippers betook themselves to the sea and therein purified both themselves and their sacrificial pigs. Later came the offering and partaking of first fruits. And on the last day *plemochoae*, the outpourings, were emptied, the one towards the East and the other towards the West. But they soon came to involve, largely if not primarily, a communion with the god in a new life beyond the grave.

Stronger meat was provided in the "Taurobolium" (bull-slaughter), which appeared in the mysteries of Cybele after the middle of the first century. Prudentius, writing about A.D. 400, gives a description based upon personal recollections. On an open platform a steer was killed, and the blood dropped down on the mystic, who was standing in an excavation below roofed over with hurdles. Through the thousand crevices in the wood the bloody dew runs down into the pit. The neophyte receives the falling drops on his head, clothes and body. He leans backwards to have his cheeks, his ears, his lips, and his nostrils wetted. He pours the liquid over his eyes, and does not even spare his palate, for he moistens his tongue with blood and drinks it eagerly. The mystic then came forward to be worshipped by the crowd, who believed he had thereby become Very God. It is no wonder that Mithraism, the worship of bulls, remained throughout a soldier's religion.

In some mysteries there was a form of baptism; Lucius in the "Golden Ass" was sprinkled, and bathed in the sea more than once; but baptism proper remains primarily a Jewish ceremony.

Again, there was some kind of a sacred meal, and to this the Christian Fathers accorded a great deal of attention and a still greater amount of abuse. When the terrestrial mission of Mithra was accomplished, so ran the myth, he celebrated, in company with the sun and the other gods, the close of their common labours, immediately before his ascension into heaven. This love-feast was taken over from the old Mazdaean religion into Mithraism as a sacrament. In the old service the celebrant consecrated bread and water mingled with the intoxicating juice of the Homa plant; for which, in the Mithraic liturgy, the juice of the vine was substituted. Christian apologists draw the inevitable parallel. Like the Eucharist, it was not granted to novices. From it supernatural results were expected; it gave wisdom of mind as also vigour of body; it was a talisman against evil spirits, and it conferred upon the worshipper, as upon his god, a glorious immortality. From this the comparison with Christianity is inevitable, and specious. Is there any connexion? If so, how much, and in what direction? Is Christianity a Mystery?

Conflicting Evidence.

When we approach Christianity we find ourselves in the same incapacity for confident statement as when confronted with the mystery religions, only from the opposite reason, that here we are overwhelmed by the masses of conflicting evidence. But to be brief, Christianity, or its officially recognized exponent, Catholic Christianity, can be traced directly back at least to Ignatius. And Ignatius, at the beginning of the first century A.D., wrote to the Ephesians of "breaking one bread, which is the drug of immortality, the antidote that we should not die, but live for ever in Jesus Christ." Here we find an early Egyptian cult phrase applied to the Eucharist, with every semblance of retaining its old magical import. Whether or no it was deliberately borrowed we shall not say. At all events, early theology viewed the Eucharist in the magic light of a mystery feast.

From the other end, Christianity can be logically and interruptedly developed at least as far, many of us think, as St. Paul. Professor Kirsopp Lake puts the break here, between St. Paul and his converts. St. Paul preached one thing, his converts read into it something else from their own environment and previous experience, and passed on the whole.

This is one theory, and I shall do no more than state it, together with a number of caveats. First, even such evidence as we have of the mysteries admittedly contains so much that is intellectual theorising and very little of what the ordinary adherents thought in practice about them. Again, in comparative religion it is most unsound to argue that any parallel necessarily presupposes any direct or conscious borrowing. No real moral teaching is ever ascribed to the mysteries. While St. Paul's teaching, even in its most sacramental aspects, can all be readily explained by the facts of his life; just as the whole growth of Christianity, even in its crudest sacramental conceptions, can all be readily explained as a logical development from Judaism with its Passover, without any references to outside influences.

Common Property.

In St. Paul there are to be found a great number of the technical words of the mysteries: *perfect, mystery, lighten, military service, justification, pre-existence, gnosis, pneuma, revelation, heavenly garment, transformation.* But many of these words and ideas are obviously common property of the age: *slavery, the prisoner of the Lord, the armour of God* . . . whatever other metaphors *could* he have used? . . . or could *they*! The Septuagint and late Judaism supply many. In the Book of Wisdom, admittedly Jewish, appears the sentence: "Wisdom is initiate into the knowledge of God," which reeks in word and content of thoroughbred mystery terminology.

I would suggest that in content also this is the end of the matter: the mystery religions arose and flourished in the common ground of human feeling, in a common sense of fellowship with the divine. The age had its spiritual need, and the mysteries arose to do their best to supply it. After some centuries the demands of the age were the more profound and still unsatisfied, and it was Christianity which satisfied them, in the highest and in a still increasingly high degree. Thus the rise of the mysteries and their power, the rise and spread of Christianity and its ultimate victory over the mysteries . . . all is explicable without any theories of interdependence. Indeed, we may now suspect that when the Fathers claimed that the mysteries were in part imitating Christian rites, perhaps they meant to be taken seriously and were even right.

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Nature Notes of the Galápagos Islands.

By John B. Hicks, F.E.S.

During the voyage of the "St. George" to the Southern Pacific many interesting places were visited and first-hand investigations made. The author, who accompanied the expedition, here gives some original notes on the natural history of a group of islands once visited by Darwin.

SITUATED immediately under the equator, some six hundred miles west of the South American continent, are the far-distant Galapagos Islands—that mountainous group of rugged, still active volcano craters, with curiously parched vegetation and a unique fauna. Although these isles appear as tiny dots on the map, they cover an area as large as the West Riding of Yorkshire, and one of them — Albemarle — is nearly a hundred miles long, rising to a height of close upon five thousand feet. Charles Darwin visited the Galapagos in 1835, in the famous ten-gun brig "Beagle," and it is said that he derived much of his inspiration for "The Origin of Species" from this group. It was Darwin who first commented upon the extraordinary tameness of its animals; how, since they had never before come in contact with men, and therefore had no hereditary instinct of fear, they welcomed their human visitors as fellow-creatures, without shyness or mistrust. A great percentage of the Galapagos fauna and flora are found nowhere else in the world, and many representatives of mainland species appear in different guise on these lonely isles of the Pacific. Here identical species of animals, birds, insects and plants differ from each other from one island to another.

THE "ST. GEORGE" AT ANCHOR IN TAGUS COVE, ALBEMARLE ISLAND.
In the distance across the straits is the volcanic Narborough Island, nearly 4,000 ft. high, whose crater is five miles in diameter and has never yet been explored.

It was my good fortune to reach the Galapagos shores in July, 1924, voyaging, as a member of the British scientific expedition, in the auxiliary barquentine "St. George," Commander David Blair, R.N.R., in command. Our first anchorage—which we gained by the help of a chart mapped by the Admiralty surveyor in the "Beagle" herself, ninety years previously—was James Bay, in James Island, and naturally I was eager to prove for myself whether Darwin's statement about the tameness of the animals still held good. It did, for hardly had I landed on the bay's sandy shore, when I was welcomed by a pair of friendly oyster-catchers; these birds greeted me, ran in and out between my feet, and would not leave me. Then, on penetrating the dense tangle of jungle between the sand and the mountains, little black finches crowded around, chattering and gossiping, doubtless wondering and discussing what kind of a strange two-footed animal I might be. The ornithologist of our expedition, Colonel H. J. Kelsall, sometimes had to undergo a dreadful ordeal. On one occasion a little yellow warbler actually flew and perched on the barrel of his gun, when he was in the very act of aiming at it. In the mountains, the great fierce-looking buzzards hovered within a foot of my head, examining me minutely and, incredible as it may seem, on one occasion a member of our party, with a little patience, was able to feed one of these prey-birds with sandwiches from his hand. In the salt lagoons by the seashore, flamingoes of gorgeous plumage, most shy of birds as a rule, showed no fear; they strutted about in their mincing manner, like so many mannequins at a dress-parade, proud to show off their fine feathers of crimson and scarlet. When a number of these flamingoes rise up from the ground and fly—especially in the rosy light of a Galapagos sunset—it is a sight not likely to be forgotten.

One of the most interesting birds in the group is the flightless cormorant (*Nannopterum harrisi*, Rothschild). It is found only in the Galapagos, and is one of the rarest birds living in the world to-day.

Its wings are so rudimentary as to be quite useless for flight, but, like its neighbour, the little white-waistcoated penguin, it becomes most graceful when in the water. So tame were these cormorants that, when we wished to examine their nests, the birds must needs be lifted off them. There are three species of booby in the islands: blue-footed, green-footed and red-footed. It is a wonderful sight to watch

HERD OF SEA IGUANA ON NARBOROUGH ISLAND.

This interesting animal is only found in the Galapagos Islands. Seen at close quarters on the right, it is the reptile alive to-day which is said to resemble most completely the giant iguanadon of prehistoric times.

these gannets dive for fish. A flock of a dozen or more will fly up high above the sea; one cries out the signal, then, all together, like falling arrows, they plunge into the water. Their wings go flat to their sides just a fraction of a second before they strike the surface. Once, when our ornithologist shot at a booby on the wing, we were amazed when there fell, hurtling through the air to his feet, not the bird, but a live fish!

But to return to the tameness of the Galapagos animals. Especially tame were the sea lions—that is, as a rule. Not only would they gambol around our boats, chasing each other from port to starboard, bow to stern, but also, should we be sitting by the coves and lagoons where they played so gracefully, they would come up out of the water to investigate us, allowing us to pat their heads as if they were dogs. Perhaps they thought that we were some novel species of sea lion. And the supposition may not be so very wide of the mark, for the ornithologist once made a very interesting experiment. A big sea lion had just come up out of the water and lay upon the shore, head erect, watching our party with interest. Whereupon Colonel Kelsall went down flat on his stomach and slithered slowly over the beach towards him, imitating the movements of a sea lion. The animal promptly went down on *his* stomach and slithered slowly towards the ornithologist. When the two had arrived within a few feet of one another, the man put his hand to his back and scratched it. The sea lion put his flipper behind *his* back and also scratched.

An amusing incident happened to Mr. W. J. A. Grant—a former arctic explorer—on Narborough Island, whose crater, five miles in diameter, has never yet been explored. He and I were sitting upon lava rocks at the edge of a tiny cove, watching a group of young sea lions playing what appeared to be a kind of water-polo amongst themselves, using a dead fish as a "ball." Pelicans and blue herons joined in the game. So interested in the proceedings were my companion and I that we were quite unconscious of the fact that the tide had risen and completely

isolated the rocks on which we sat. Suddenly one of the young sea lions quitted the "polo" and came up to my explorer friend, sniffing him. He, wishing to avoid trouble with its mother—a ferocious-looking old lady who watched her offspring jealously—tried to dodge the youngster, but it was too late. The mother gave a mighty bellow and rushed at him, placed her nose beneath his uplifted legs and tipped him head over heels—splash!—into the water.

Talking of intelligence in animals, I must relate a curious affair which I witnessed in James Bay. A thick and weighty hook, attached to a chain, which itself was fastened to a very thick rope, had been lowered from the ship into the sea. Baited with a chunk of pork, very "ripe," it tempted a tiger

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shark some twelve or more feet in length, which got well caught up with the hook in his mouth. But suddenly the monster leapt clear out of the sea, described a back-somersault, at the same time biting clean through the rope! He was away like a flash of lightning, bearing chain and hook as a grim memento of his escapade.

To my mind, by far the most interesting animal of the Galapagos is the great sea iguana, named by Darwin *Amblyrhynchus cristatus*. Not only is it peculiar to the group and, so far as is known to science, the only marine iguana in the world, but it is said to be the reptile alive to-day which bears the most complete resemblance to the gigantic iguanadon of prehistoric times. It is, in fact, a most interesting survival and, like the New Zealand *Sphenodon*, another survival from remote ages, it has the "pineal eye," a rudimentary third eye in the roof of the brain. *Amblyrhynchus* is coloured elephant-grey to match the lava rocks on which it loves to bask; measures from three to four feet in length; has an upright spiny crest along the entire length of its back and muscular tail; swims wonderfully with the help of the latter; and feeds on seaweed. Looking at these hideous amazing creatures, it is indeed hard to believe that they belong to this twentieth century, and that they are (happily) vegetarians.

Much could be said of the entomological wonders of the Galapagos so ably "worked" for our expedition by Miss L. E. Cheesman, Mr. C. L. Collenette and Miss C. Longfield. Amongst other interesting insects, the island group has a butterfly of its own, a large dark brown "skipper" (*Eudamus galapagensis*, Williams), with tails on its hind wings; and I shall never forget the exercise which it gave me when, together with our artist, Mr. Montague Dawson, I chased it amongst the acacias and wild cotton which grew on the steep walls of an old crater, behind Tagus Cove, Albemarle Island, where the "Beagle" once anchored. But some of the most important discoveries of the expedition are to be found in the collections made by Dr. Cyril Crossland,* the celebrated marine biologist, for this branch of science in the Galapagos had received but scant attention before the visit of the "St. George." There is a beautiful marine garden at Tagus Cove. Below the sea's surface are delicate organisms of wondrous shape and colour, some like a lady's fan, some like a Spanish comb, but most like flowers. Mr. L. A. M. Riley, who is our leading authority on the South American flora, and who accompanied the "St. George" expedition, describes, as a result of the latter, three botanical species from the Galapagos as being new to science, including a tomato (*Lycopersicum cheesmanii*, Riley).

It was our sole regret that we did not come across those giant tortoises from which the wonderful island group derives its name.

* For an account of this branch of the work see "the Voyage of the 'St. George' to the South Pacific." By Dr. Cyril Crossland. *Discovery*, November, 1925.

Discovering American History in England.

By Allen French,

Author of "The Day of Concord and Lexington."

On a return voyage from the United States some years ago, the Editor first met the author of the following article, who was about to study British documents on the War of Independence. This acquaintance was renewed on Mr. French's subsequent visits to England, and as a result, himself resident in Concord and a foremost authority on its historic neighbourhood, he has written for "Discovery" on his investigations.

It may seem odd that an American studying the Siege of Boston, which took place in 1775 and 1776, should go to England for his material. But in the first place, all early American history is being re-written from a new point of view; and in the second, not only has much new material been discovered (and I have discovered some myself) but England is the best place in which to find more.

That is the argument which, in various forms, I have put to many of my neighbours here in America. To speak of the larger field of our Revolutionary history, in which American books have often been written with great prejudice, it has long been recognized that they should be superseded, and the work has been proceeding fast. Hand in hand with this goes on the search for new material, for lost facts, and this search can be most successfully carried on in England.

The reason for this last is very simple. The revolutionary war was from the first regarded in America as one of our heroic periods; all the documents were cherished, and most of them published early. While many letters and diaries may yet be found in America, they are not likely to be important. As for our official

papers, they have been exhaustively studied, and have long been well known. On the other hand, English interest in the American Revolution has never been strong. Even at the time the danger to England from the transatlantic struggle soon was obscured by the danger from the European war; and the American fighting, dreary and profitless, was forgotten in favour of the fighting with France and Spain, where honour was won. When later an English historian wrote upon the American war, he wrote either with a prejudice equal to our own, or with indifference; and the letters home, the diaries written by our soldiers in America, the official papers, were neglected if not forgotten until recent years.

Even before 1900, American writers were becoming aware that our histories were, to speak frankly, too often vainglorious and unfair. Especially so were our school histories, which for over a century had fostered prejudice against Great Britain. It may have been the friendly attitude of the English in the Spanish-American war which first brought home to America at large that England was not so black as she was painted. At any rate, from about that period may be dated the notable growth of the movement to rewrite American Revolutionary history, a movement which may now be said to dominate all new books in that field.

Contemporary Documents.

For my own part, limited as my subject is, it is a particularly fruitful one. Including as it does the dramatic events of Concord and Lexington, when the war began, the battle of Bunker Hill, and the Evacuation, as well as the daily incidents of a siege, it provided plenty of material for diary and letter writing. When Howe sailed away with his fleet, the officers and the loyalists carried away with them their private papers, and the leaders wrote reports. Most of these documents drifted to England, where a good proportion of them has been preserved, not necessarily in public repositories, but frequently in private hands. And not merely the manor-houses and castles contain the documents which I have twice come to England to search for, but the simpler homes of plainer people, who have kept ancestral papers with a care which has always had to be conditioned by changes of residence and family fortune. It is easy enough to go to the well-known places of deposit, and by a little diligence find something worth while. To find the private papers is very much a matter of luck.

To illustrate this, let me tell the story of my discovery of the diary of Adjutant Frederick Mackenzie, of the Royal Welsh Fusiliers, the Boston part of which I am just publishing in book form. Nearly forty years ago a young American woman, married to an Englishman, happened upon this diary, and recognizing in an entry a narrative of much importance to students of American history, copied it and sent it to Boston, where it was printed in the *Proceedings* of the Massachusetts Historical Society. The entry was of the 19th of April, 1775; it told the story of the march of the brigade under Lord Percy to Lexington, the rescue of the expedition driven back from Concord, and the difficult return to Boston under the fire of the minutemen. It is a clear soldierly report of an afternoon of hard fighting, and has always been recognized as the best story of that part of an important day.

A Search for a Diary.

Having finished a book about this opening day of the Revolution (in which I depended very much upon this Mackenzie diary), I had taken up the study of the siege which immediately followed, when for eleven months the British Army was penned in Boston by the provincials. It was evident to me that the remainder of the Mackenzie diary, if it could be found, might provide very valuable historical material; and it was my particular hope that it would provide descriptions of Bunker Hill and the Evacuation. But where was it to be found? A letter to the curator of manuscripts at the British Museum brought the information that it was not there, but brought also the address of the lady who had made the first extract from the diary. From her, however, I learned only that the diary was probably lost, as it was not found among the effects of a gentleman, deceased some years ago, who (she thought) had originally allowed her to copy it. But her statement only made me the more keen to find the diary, as she told me that there had been some thirty volumes.

In advance of my coming to England in 1925 I wrote, therefore, a letter to the London *Times Literary Supplement*, stating my general desire to find documents concerning Boston in 1775 and in 1776, but particularly mentioning the Mackenzie diary. And soon after my landing in England I received a letter from a Lieut.-Colonel Mackenzie, stating that the diary was in his possession and at my service. When I called upon him I found that the diary had always been in the possession of his family; my correspondent had been mistaken in supposing that she had seen it elsewhere. But to my regret I found that but eight volumes now remained; the others had been inexplicably lost, and the remaining diary, in its Boston part, carried the story not even to Bunker Hill.

However, what still exists is valuable, and I expect that the present small printing of it will find a ready sale among those who are interested in Revolutionary Boston.

There is a curious sequel to this story of Adjutant Mackenzie and his habit of record-keeping. It happened in the following summer, of 1926. I had not for some time seen the adjutant's handwriting—fine, a little feminine, and not very individual. Being again in England, I had the good fortune to be given an introduction to the librarians at the War Office, a place which is, I am told, difficult of entrance, though the cordiality with which I was received was perfect.

Evidence from Handwriting.

I stated my hope of finding manuscript material dealing with the Boston Revolutionary period. The answer was given with a shake of the head: the War Office Library had almost no manuscripts. Yet there were four manuscript books, written by the same hand, of that period, though not all of them dealt with Boston. They were produced for my inspection. Three, as I readily saw, did not deal with Boston at all.

The last, which I took up with fading hope, was by the same hand—fine, a little feminine, and not very individual. It was an orderly book. I was disappointed to see that it began in New York—the date, I noticed, was almost exactly that of Mackenzie's landing there in 1773, but presently the writer was transferred to Boston—and the date, August, 1774, was that of Mackenzie's coming. Then my mind began to awake, and I recognized the handwriting.

The librarian at my elbow replied, "Mackenzie; Yes, the name is in one of the other volumes. But who was he, and what do you know about him?" He was almost as pleased as I, when I explained who the adjutant was, and that here in his book were facts which I had as yet found nowhere else.

This was luck; and luck, as I said, is the most important factor in finding documents outside of the great archives. Fortune alone put me in possession of these books by the diligent writer of a hundred and fifty years ago; and fortune may yet bring under my eye the remaining volumes of the diary.

It will be noted that one of these volumes was an orderly book—that is, a book of the daily garrison orders. I was already on the track of another, because in the previous year a letter in answer to my inquiry in *The Times* had informed me that such a thing was at the headquarters of a well-known corps. In 1925, however, letters to the barracks had failed to draw out a reply; and in 1926 I had already written once (from a little town in France, before coming to England) and had received no answer. While puzzling how to make my application effective, fortune again came to my aid.

In this little out-of-the-way town there was a friendly group of us, English, Americans, and French. To the hotel where we met there came a tall Englishman to whom we were at once attracted, but to whom we were too wise to speak at once. The acquaintance of your true Englishman cannot be rushed! We gave him three days in which to see that we were decent folk, and then when I spoke to him he was ready to be friendly. When later I told him of my quest (as I tell all English, in the hope of finding ancestral papers of the siege) and explained my puzzle in regard to this particular orderly book, he said, "Why, my brother is the top thing in that corps. I will write him." And the deed was done. Properly vouched for, I was welcomed at the barracks with great hospitality, and for three days worked with my wife in the commandant's dining room, copying from the orderly book most illuminating passages revealing the life of the soldiers at the Siege.

Manuscripts awaiting Discovery.

This is not the whole of this side of my story. I could tell of friendly welcomes at old English family seats, and contrast them with a most interesting visit to the house of a self-educated man in a manufacturing city, where strangely enough I found a letter written from Washington's camp, the property of a gentleman living not thirty miles from me in Massachusetts. But I have not the space for all this, and can only draw my double moral. The first part is that England still contains in private houses many unpublished and even unknown manuscripts, to be found by persistence coupled with good fortune. And the second is that the welcome accorded by the owners of the manuscripts is always kindly. I know from experience that the traditional stiffness of the Englishman is only a proper reserve coupled often with a most engaging shyness, and that once within that barrier the welcome accorded to American historians is very genuine. Nor is the story different when one comes to study at the great British treasuries of documents.

To work in the manuscript room at the British Museum is a most interesting experience. The great bound catalogues are on the shelves. If ever the Museum takes up the card catalogue system the work will be easier for the student; but then he would lose the impressive knowledge of the great collections made in years past by individuals of families, which

one by one have passed into the keeping of the nation. The Arundel, the Burney, the Harleian and Sloane, the Lansdowne, Stowe and Kings, and beyond these, the great lists of additional manuscripts acquired from many sources, show how for generations the small and the great have worked together to make this deposit of historical material the most important of its kind in the world. The student labours through the catalogues; at his request there is laid before him any item that he wishes to see. He may study maps and diaries, single letters or a whole correspondence, a man, an event, or an epoch. The officials are interested: they make suggestions, and once came a prized invitation to tea. The one drawback to work in the manuscript room is that recent accessions have not been catalogued in a form easily consulted, but that is a difficulty that I have found very noticeable in much smaller collections.

The Record Office is another repository of documents, but of another kind. Here have been gathered together the official reports, the masses of correspondence of the War Office, the Admiralty, the Colonial Office—all the departments of government, in fact, since their foundation. Very ancient material emerges from the recesses of the building, to be laid before the "searchers" in the round room where I sat; I saw many a fragmentary parchment, in Old English script, pored over and copied. But for me and for my wife, working at my side, the interest centered in the year of the Siege, as reflected in "in-letters" and "out-letters" carefully preserved in great books or in bundles of folded and docketed papers. It was not dry, but was really fascinating, this hunt among these masses for new facts. Cool and official as the out-letters were, the in-letters were frequently very human, with their petitions, explanations, and the relation of events. There turned up among them two accounts of Bunker Hill, both new to me. Nor was the American side neglected, for here were captured papers, one recording the beginning of the American navy, in a commission signed by Washington, directing a captain in his army to take command of a schooner and harass British shipping.

The Background of History.

There is of course a good deal of drudgery in poring over catalogues, in handling the big volumes of documents and reading many pages which are of no value, and finally in copying the extracts which one needs. (To be sure, much can be photostated, and the result is an exact facsimile; but that is expensive, and often only a little is needed from each page, making photostating wasteful.) But apart from the constant hope which keeps one going, the mere drudgery has its value; for out of all the mass that is read and discarded, without a word being copied, the reader unconsciously constructs a background of his history, a world strangely real in which, for the hours of his study, he lives with the odd moving-picture of forgotten lives. Leaving the silent Record Office after a day of such work, I have blinked at the sun and winced at the roar of nearby Fleet Street, finding it difficult in the first moments to bridge the gap of a hundred and fifty years.

Value Unsuspected.

My two short summers in England have not brought me enough. To be sure they have given me good things, but only to show me that many more are to be had. For there are other libraries, great and small, in more than one part of Great Britain, where manuscripts have been gathered; and there are still in private possession ancestral letters and diaries written by actors at the Siege. By industry, one by one the great collections can be visited; but the other factor, fortune, is needed to bring out from desks and even bookcases and even from garrets the neglected manuscripts whose historical value to students like myself is unsuspected by the owners. It is scarcely two years since the forgotten papers of General Henry Clinton, who was prominent at Bunker Hill, were brought to light; and though such a find will not happen again, there must be minor discoveries ready for the diligent or lucky searcher. I must go again to England, in the hope of adding to the store of my material.

And whatever be my fortune in making discoveries, I am sure of at least one thing, that the work will be pleasant beyond description. And this is not only because England is lovely, and to every American the home of romance. That goes without saying. But it is also because of that feeling of relationship between English and Americans which still subsists in spite of all that has happened to cause estrangement, especially since the War. The American historian is not coldly greeted; he is cordially welcomed. And this is not a matter of 1775, but of 1926. What separated the nations long ago, largely through misunderstanding, has gone by; but the blood kinship remains, and by individual contacts it is kept alive. I hope to see the feeling grow. To me England is a treasure-house, not merely of bygone things, but of great promises for the future, to rise from the essential underlying unity of the two nations. So far as a single writer can forward this, I hope to do my part, and while discovering in England the story of the past, to build a little for the future.

Fossils: A Study in the History of Discovery.

By F. J. North, D.Sc., F.G.S.

Department of Geology, National Museum of Wales.

In discussing fossils, what they are and what they were thought to be by an early school of geologists, Dr. North shows from their history how scientific discovery is often hindered by current tradition and prejudice.

"But the mortellest enemy unto knowledge, and that which hath done the greatest execution unto truth, hath been a peremptory adhesion unto Authority, and especially the establishing of our beliefs upon the dictates of Antiquities."—*Sir Thomas Browne* (1646).

HISTORY shows that many discoveries have been delayed because of a reluctance to admit that which is obvious, when it happens not to be in accordance with current popular beliefs. This is illustrated in an interesting manner by a study of the changes in the views that have been held as to the origin of the bodies we now call fossils. Now that their true nature and significance is understood, fossils are proving of the utmost value to those concerned with the discovery and exploitation of oil, coal, and many other commodities of great use in the service of man; they have made it possible to determine the succession of living things which have populated the earth, and they have thrown light upon the geographical changes which preceded the formation of our continents and oceans.

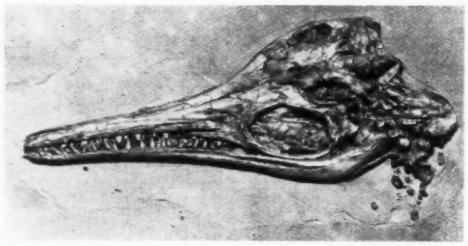


FIG. 1.
FOSSIL SKULL OF A MARINE REPTILE (*ICHTHYOSAURUS*).
A specimen about 15 inches long, unearthed near Penarth, Glamorgan, and now in the National Museum of Wales.

The practical application of the study of fossils is, however, of comparatively recent origin, and the views which we now hold have taken shape only during the last few decades, although they were anticipated by several writers from Herodotus to Leonardo da Vinci, who lived in the latter half of the fifteenth century, and who, although best known as an artist and architect, was one of the first to appreciate properly the significance of fossils. For more than two centuries after da Vinci wrote, knowledge of the distribution of fossils steadily increased but ideas concerning their nature were so influenced by the opinions then held upon the subject of the origin of the earth, that no real progress was made until towards the end of the eighteenth century, when a few patient workers in this country and on the Continent abandoned ingenious speculation for careful observation.

A review of the whole literature of fossils would occupy more space than is here available, but in the following notes it is proposed to discuss one particular school of thought which flourished towards the end of the seventeenth century and in the early part of the eighteenth century; and a brief account of present-day views concerning the origin of fossils will make what follows more easily appreciated by those who have not given much attention to the study of geology.

At the present time, rain and rivers wear away the surface of the land, and the sea erodes the coast; the material so produced, which may be mud, sand, or pebbles, according to its size, is spread out as sediments upon the floor of the ocean.

When marine animals die, their bodies fall to the bottom, and unless eaten by other creatures their

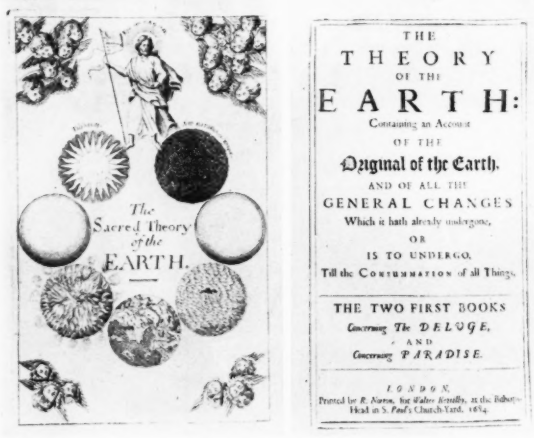


FIG. 2.
THE TITLE PAGE OF BURNET'S "SACRED THEORY OF THE EARTH." 1684.
Among the illustrations in the frontispiece are seen the earth before the Flood; the Ark floating during the Flood; and the present continents after the water had subsided.

shells, their bones, and any other durable parts they may have developed remain behind when the flesh has decomposed, and are covered with the sediment that is accumulating. If, subsequently, movements in the earth's crust should cause that sea floor to become part of a continental mass, the once soft sediments would constitute the rocks of the new land area, and unless dissolved away by percolating waters, the shells and bones that had been mixed with the sediment would be found embedded in those rocks.

Many of the rocks which enter into the formation of the earth's crust were formed as sediments in seas or lakes that existed in the past, and we therefore find in them, usually as impressions, or casts, or petrifactions, the remains of the earth's former inhabitants, and such remains are known as fossils (Fig. 1).

The wearing down of land areas, the formation of sediments, and the interchange of land and sea, have been in operation continuously since rain first began to fall upon the earth, so that in such rocks as have not been destroyed in the process of making new rocks elsewhere, we have a record, all too scanty, of the animals and plants by which the earth was populated in the past.

During the middle ages it was almost universally held that the Mosaic account of the Deluge was to be interpreted literally as relating to a catastrophe of world-wide occurrence, and any opinions expressed concerning the origin of the rocks, and therefore of the fossils they contain, had to conform to the requirements of that story, or their authors incurred the displeasure of the Church, which few were willing to do. We accordingly find that, although there was a genuine desire to compile a satisfactory "theory of the earth" most of the books upon the subject consist of ingenious attempts to explain the formation of all rocks as the result of a universal catastrophe (in which case, of course, fossils were relics of "antediluvian" life, buried in the mud left when the water retreated). For example, in 1684 Dr. Thomas Burnet published his "*Telluris Theoria Sacra*" or "Sacred Theory of the Earth" (Fig. 2) in which he argued that originally the world was a mixture of earth, water, oil, and air, which gradually consolidated and became a sphere with the heaviest solid material in the centre; surrounding this was a layer of water, whilst outside all was the oily layer and the air (Fig. 3). The dust in the air gradually settled out and, with the oil, formed a kind of superficial fatty scum on which plants, animals, and human beings lived, and from which they derived their nourishment. The surface of the young earth was quite smooth, and there were neither mountains, rivers, nor seas. After about 1,600 years the thin outer layer had become so dried by the heat of the sun that it began to crack. The consequence was that as the water below became heated, the vapours which rose through the cracks mixed with the air, giving rise to fearful storms, and the superficial layer broke up and subsided into the watery layer beneath. As the fragments fell they were heaped up one upon another and formed mountains, valleys and islands. This great catastrophe was the deluge in which Noah figured, and which destroyed nearly all the plants and animals (Fig. 4); and our author passing from the past to the future went on to show that one day the present condition of things will be destroyed in a universal conflagration, and a second chaos will prevail.

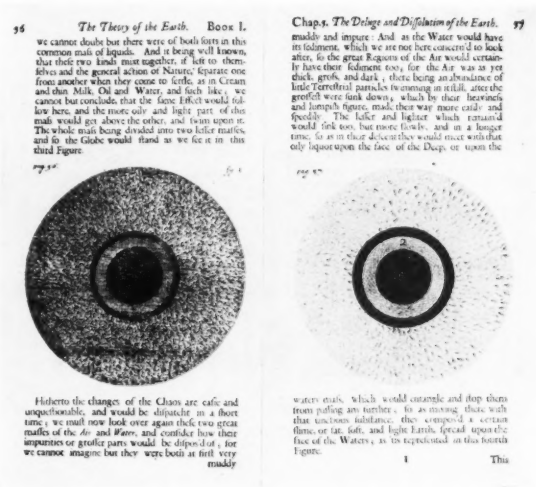

96 The Theory of the Earth. Book I.
we cannot doubt but there were of both sorts in this common mass of liquids. And it being well known, that these two kinds must together, if left to themselves and the general action of Nature, separate one from another when they come to settle, as in Cream and thin Milk, Oil and Water, and such like; we cannot but conclude, that the same Effect would follow here, and the more oily and light part of this mass would get above the other, and swim upon it. The whole mass being divided into two leſſer masses, and so the Globe would ſtand as we ſee it in this third Figure.
Hitherto the changes of the Chaos are eaſie and unquestionable, and would be dispatcht in a short time; we muſt now look over again theſe two great maſſes of the Air and Water, and conſider how their impurities or groſſer parts would be disposed of; for we cannot imagine but they were both at firſt very muddy
Chap. 5. The Deluge and Diſſolution of the Earth. 97
muddy and impure: And as the Water would have its ſediment, which we are not here concern'd to look after, ſo the great Regions of the Air would certainly have their ſediment too, for the Air was as yet thick, groſs, and dark; there being an abundance of little Terreſtrial particles ſwimming in it ſtill, after the groſſeſt were ſunk down, which by their heavineſs and lumpish figure, made their way more eaſie and ſpeedily. The leſſer and lighter which remain'd would ſink too, but more ſlowly, and in a longer time, ſo as in their deſcent they would meet with that oily liquor upon the face of the Deep, or upon the
waters maſs, which would entangle and ſtop them from paſſing any further, ſo as mixing there with that tenacious ſubſtance, they compoſed a certain ſlime or fat, ſoft, and light Earth, ſpread upon the face of the Waters, as its repreſented in this fourth Figure.
I This

FIG. 3.
ILLUSTRATIONS, FROM BURNET, SHOWING STAGES IN THE FORMATION OF THE EARTH BY THE SETTLING DOWN OF THE PARTICLES CONSTITUTING THE CHAOS.
On the right is the earth before the thin solid outer layer broke up and subsided into the watery layer beneath.

Burnet was both eloquent and clever, and his work, which was subsequently translated into English, found much favour with some of his contemporaries. Addison made it the subject of a Latin ode, and Steele praised it in the *Spectator*; it was admired by Charles II (to whom the English edition was dedicated) and won for its author an appointment in the Court of William and Mary. His theory, although very ingenious, owed more to his imagination than to his knowledge of the rocks, and it is interesting to find that in a later work, in which he endeavoured to reconcile his theory with the first chapter of Genesis,

FIG. 4.
"SACRED THEORY OF THE EARTH."
Illustration showing the breaking up and subsidence of the earth's outer crust at the time of the Flood, and the formation of mountains and of islands.

he suggested that the Mosaic account of the creation was allegorical and not to be literally translated! Like his "Sacred Theory" the new work, "*Archaeologia Philosophicae,*" was a strange mixture of what we should now call science, and theology; and not only was his attack upon the writings of Moses viewed with disfavour, but an account of the conversation between Eve and the serpent gave great offence and, in consequence, he had to resign his post as Chaplain in Ordinary to the King. "*Archaeologia Philosophicae*" was satirised by Dr. William King, in one of whose ballads Burnet is represented as saying:—

"That all the books of Moses
Were nothing but supposes."

John Woodward, who was one of the first in this country to make a systematic collection of geological specimens, also attempted an "Essay towards a Natural History of the Earth" 1695 (Fig. 5). He was actuated by a commendable desire to make a contribution to the scanty knowledge concerning the earth's origin, for he wrote:—"Assuredly, that Man who should spend his whole Life in amassing together Stones, Timber, and other Materials for Building, without ever aiming at the making of an Use, or raising any Fabrick out of them, might well be reputed very fantastic and extravagant. And a like Censure would be his Due, who should be perpetually heaping up of Natural Collections without design of building a Structure of Philosophy out of them, or advancing some Propositions that might turn to the Benefit and Advantage of the World. This is in reality the true and only proper End of Collections."

Unfortunately, he regarded the Deluge as the principal event in earth history, and interpreted all his evidence accordingly, with the result that the "Structure of Philosophy" which he raised was, as we shall see, of so flimsy a character that it tumbled down almost before the ink was dry. He considered, rightly, that fossils represent the shells of marine creatures, but he supposed that they were all entombed at one time—during the Universal Deluge.

"At the Deluge," he wrote, "the Earth was destroyed, all the Solids of it, Metals, Minerals, Stone, and the rest, dissolv'd, taken up into the Water, and there sustain'd along with the Sea-Shells; till, at length, all settled down again, and form'd the Strata of the present Earth. The Shells, being thus lodg'd amongst this stony Matter, that afterwards became Solid, when this comes now to be broke up it exhibits impressions of the Shells, lodg'd in it; showing, even the hardest of it, to have been once in a state of Solution, soft, and susceptible of Impression." In explaining this great catastrophe he wrote, "All rocks were so far dissolved as to be reduced to their single atoms and principles; no two of these remained united or coherent . . . the Gravity of all bodies, solid and fluid, for some time ceased and deserted them. Things therefore standing thus, the Consequences of them are very evident, and obvious. Upon the Cessation of the Gravity of the Ambient to which the rocks owe the Cohesion of their Parts, their Solidity would instantly cease, and the Corpuscles fall asunder." At this juncture one is inclined to suspect a weak link in his chain of argument for, if at the Flood all the rocks of the earth disintegrated into their component parts—how came the fossils to remain intact? His ingenuity is equal even to this, for he continues—"But that would not in the least affect the animal and vegetable Bodies; the Cohesion of whose Corpuscles arose from . . . the twisting, weaving, and combination of those Corpuscles amongst themselves . . . so that they must remain as firm and intire as if no such thing had ever happen'd.

"This may be illustrated by the Example of the Magdeburg Experiment, in which Two pieces of Marble, having their Surface exactly plane, polite and apply'd to each other in such manner, as, so far as they are contiguous, to intercept the Air, do cohere firmly together as

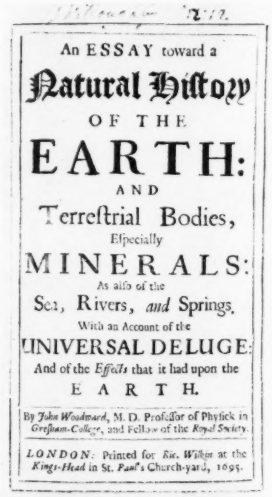

An ESSAY toward a
Natural Hiſtory
OF THE
EARTH:
AND
Terreſtrial Bodies,
eſpecially
MINERALS:
As alſo of the
Sea, Rivers, *and* Springs.
With an Account of the
UNIVERSAL DELUGE:
And of the *Effects* that it had upon the
EARTH.
By *John Woodward*, M. D. Profeſſor of Phyſick in *Greſham-College*, and Fellow of the *Royal Society*.
LONDON: Printed for *Ric. Wilkin* at the *King's-Head* in St. *Paul's* Church-yard, 1695.

FIG. 5.
TITLE PAGE OF WOODWARD'S "NATURAL HISTORY OF THE EARTH," 1695.
An example of the long descriptive titles then in vogue.

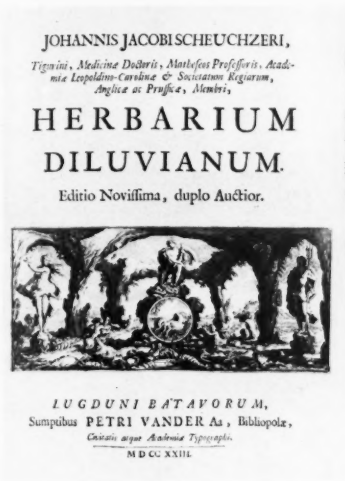

JOHANNIS JACOBI SCHEUCHZERI,
Tigurini, Medicinæ Doctoris, Matheseos Professoris, Academiæ Leopoldino-Carolinæ & Societatum Regiarum, Anglicæ ac Prussicæ, Membri,
HERBARIUM DILUVIANUM.
Editio Novissima, duplo Auctior.
LUGDUNI BATAVORUM,
Sumptibus PETRI VANDER Aa, Bibliopolæ,
Cæsareæ atque Academiæ Typographi.
MDCCXXIII.

FIG. 6.
THE TITLE PAGE OF "*HERBARIUM DILUVIANUM*" (1723)—
showing, apparently, Neptune watching the retreating waters of the Flood.

Same time, two Pieces of Cord that were firmly complicated and tied into a Knot; 'tis plain the drawing out of the Air would contribute nothing to the loosing of that Knot, or untying the two cords.

"And this was the very Case of the animal and vegetable, and of the fossil Bodies, during the time that the pressure of the Ambient was taken from off them at the Deluge; and lets us clearly into the Reason why these were not dissolved as well as the rocks."

Woodward not only demonstrated (to his own satisfaction) that fossils prove the occurrence and the universality of the Deluge, and that the Deluge explains the existence of fossils, but by means of certain fossil plants endeavoured to show that the catastrophe took place in May and not in August as other authorities were inclined to believe.

His arguments were based upon hazel-nuts found in peat, and upon fossil plants found in the coal-bearing strata. Of the former, he said "they appear to be of about the same growth and condition that hazel-nuts usually are at the end of May or the beginning of June," and of the latter, that they resembled modern ferns "collected about the end of May, the time that the Deluge coming on, put a stop to the growth of the vegetables then in being."

one; the Gravity of the Air without, pressing and holding them together. These two pieces of marble thus conjoin'd, being put into a receiver, and the air exhausted, immediately disunite, and fall asunder. But if there were put into the Receiver at the

Unfortunately, however, he failed to realize that millions of years must have elapsed between the formation of the coal-bearing strata with their fern-like impressions and the peat in which hazel-nuts occur.

The importance of the Flood was also emphasized by a number of writers on the Continent. Among these was Johann J. Scheuchzer of Switzerland; he at first regarded fossils as accidental markings of inorganic origin, but Woodward's work so impressed him that he translated it into Latin, and became one of its most enthusiastic protagonists. His "*Herbarium Diluvianum,*" 1723, has on the title page (Fig. 6), an interesting picture apparently depicting Neptune watching the retreat of the waters of the Flood, leaving all kinds of marine creatures stranded upon the shore; and in a number of excellent plates he illustrates many kinds of fossils from various geological formations (Fig. 8). In some of his figures, however, he indulges in curious flights of imagination: for example, in a crystal of quartz with moss-like inclusions of other minerals he saw a well-executed landscape (Fig. 7). Near Oeningen he discovered fossil bones which he believed to be "the bony skeleton of one of those infamous men whose sins brought upon the world the dire misfortune of the Deluge," but many years later Cuvier showed that the bones were those of a giant salamander which lived during the Tertiary era!

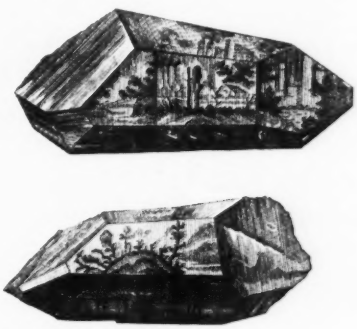


FIG. 7.
CRYSTALS OF QUARTZ
with moss-like or dendritic inclusions of other minerals, from an illustration in "*Herbarium Diluvianum.*" In one of the crystals Scheuchzer thought he detected an arrangement of the included mineral, suggesting a landscape picture.

In any theory which assumed the occurrence of a universal deluge one of the greatest difficulties was to account for the appearance and disappearance of such vast quantities of water.

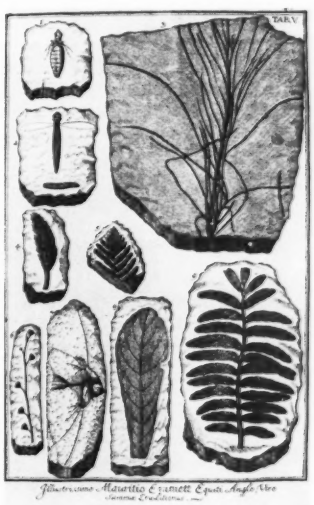


FIG. 8.
FOSSIL FISH, PLANTS, AND INSECTS FROM SCHEUCHZER'S "*HERBARIUM DILUVIANUM.*"

Burnet's view has been referred to; Woodward imagined a great abyss from which the water came and to which it subsequently retired, and others, whose works have not been mentioned owing to consideration of space, assumed an original external ocean which disappeared into subterranean reservoirs; but William Whiston, then chaplain to the Bishop of Norwich, was even more ingenious. He was at first one of Burnet's followers, but later disagreed with him, and in 1696 published "A New Theory of the Earth: wherein the Creation of the World in Six Days, the Universal Deluge and the General Conflagration as laid down in the Holy Scriptures are shown to be perfectly agreeable to Reason and Philosophy." In it he criticized Burnet's view as to the origin of the water of the Deluge. The great comet of 1680 was still fresh in people's minds, and Whiston regarded the earth as having originated in a comet which passed so near to the sun that it melted into a compact mass, and afterwards re-arranged its material with the heaviest particles in the centre; the Deluge he regarded as having been caused by the near approach of the earth to another comet, which precipitated the moisture in its tail, and set up strains which caused the escape of subterranean waters.

While some men tried to show that fossils were relics of the Deluge, others realized that no single catastrophe could have accounted for the formation of all the rocks in which fossils occur; but the idea of past changes in the distribution of land and sea, suggested nearly two centuries before by Leonardo da Vinci, and in 1669 by Nicolaus Steno, a Dane then resident in Tuscany, had not received as much attention in this country as they deserved; and the theories proposed to account for the existence of fossils by those who held neither of the views that have been discussed, were not less extravagant than those of Burnet and of Woodward. They are of sufficient interest to form the subject of special study, but what has been written certainly justifies the words of old Sir Thomas Browne with which this paper commenced, and recalls others penned by Michael Faraday —"The philosopher should be a man willing to listen to every suggestion, but determined to judge for himself. He should have no favourite hypothesis, be of no school, and in doctrine have no master."

Correspondence.

RESEARCH ON BRITISH SPAS.

To the Editor of DISCOVERY.

SIR,

The annual meeting of the British Spa Federation, held in London last week, coincided with the delivery at Torquay of an important speech by Mr. A. M. Samuel, M.P., the Minister for Overseas Trade, in which he urged the spas of this country to develop, amongst other things, "scientific research into the chemical and physical properties of their medicinal springs." A memorandum on this very question was before the Federation at their recent autumn meeting, and was referred to the individual spas for their consideration.

The favourable reports received enabled the Federation last week to decide upon a scheme for the publication, as soon as the material is all available, of detailed information of all kinds relating to the waters and to the geology of the springs. A good deal has already been done in the matter of scientific investigation at some of the spas, and work of the highest value has been carried out. Some foreign countries have issued elaborate works on this subject, but the importance both of publishing existing information and of further investigation of the British mineral waters is only just being generally appreciated. A special sub-committee, consisting of the scientific officers of Bath, Buxton, and Harrogate, was appointed to advise as to the best method for collecting and collating existing information, and after consultation with the medical profession to consider the lines upon which further investigations can be most usefully made.

Closely connected with this are the lectures on medical hydrology which are now given at intervals at many of the universities and medical schools by leading medical authorities on the subject. This special educational work is undertaken by a body known as the Committee for the Study of Medical Hydrology in Great Britain in conjunction with the British Spa Federation, and is only one part of the scientific development of our spas in recent years.

JOHN HATTON,
Hon. Secretary,
British Spas Federation.

The Hot Springs, Bath.
9th March, 1927.

THE CANADIAN MUSK PLANT

To the Editor of DISCOVERY.

SIR,

More particularly for the benefit of those who are not yet regular readers of *Discovery*, it may be interesting to draw attention to the sequence of events disclosed by the correspondence which has appeared under the above title.

A letter from Canada, in your Christmas number, expresses willingness to supply local information on points that may be of value to research workers in the home country. An English reader, prompted by this invitation, takes advantage of it to inquire about a plant that has evidently altered in character since its importation many years ago from Canada. By return of post not only does the original correspondent send an answer, but a reply is also received from another reader in British Columbia. As illustrating the wide influence of communications to your pages, a summary of this particular correspondence deserves to be put on record.

Yours, etc.,
F. E. HAMER.

Chiswick.
16th March, 1927.

Is Air Power a Delusion?

By Arthur Hungerford Pollen.

By special permission of the publishers of "The Great Delusion," we reproduce below part of its preface by Mr. Hungerford Pollen, who is, of course, well-known as a writer on naval strategy. The sensational challenge of this new book to generally-accepted views on aircraft and their future is already provoking widespread interest and controversy. (We have inserted the sub-titles in the following pages.)*

In the preliminary part of his preface, Mr. Hungerford Pollen compares the newest developments of wireless and aviation—transatlantic telephony and the flight to India—with the earlier discoveries of steam and the electric cable. He comments on the marked dependence of wireless on atmospheric conditions, as a result of which it was found impossible on the opening day of the American service to complete all the calls which had been booked. Mr. Pollen proceeds :—

Is not the difference between the two groups something like this: The advances of our day have truly enabled us to do things that can be done no other way. And, unquestionably, these are things that might occasionally be of very great value. The steamship, the steam engine, the motor-car, and more particularly the electric telegraph have, that is, left gaps. The aeroplane and the wireless have filled the gaps. The wonder of these things is so great that we are tempted to forget first that the gaps are narrow, next that they are only sometimes filled, and lastly, only filled at enormous cost. It would be great fun to have an Aladdin Lamp if the Djin came up smiling whenever the lamp was rubbed, and then did your bidding with the swift celerity of the fairy tale. But if he came when the spirit, and not the lamp, moved him, and only did his job when the weather permitted; if when you asked for a magic carpet to Karachi, he might casually drop you into the Mediterranean with no other apology than it had been quite impossible to foresee that the meteorological conditions would be so bad; and finally, if he never did even the smallest job except in exchange for a cheque that left your bank account spavined for good and all—why, then, shares in "Magic Lamps Limited" might stand at a heavy discount.

The Truth about Flying.

Thus, the happenings of yesterday prepare us for the book it is my business to introduce to-day. If the publication of "The Great Delusion" is an event, it is simply because the truth about flying is at last told. And it is not a comforting truth. . . .

The strange thing is that, despite the rudeness of the onslaught, no new discoveries seem to have been made. No hoard of secrets has been unearthed. The physical laws that govern flight have been set out. A long array of facts have been collected which tend to show that our expectations from aircraft never have, and never will, be realized. But they are neither new, nor hitherto hidden, nor inaccessible facts. They have been amassed by diligent search from such universally available authorities as Hansard, the daily papers, and the scientific journals. "Neon" has, in fact, done little more than quote the laws, and collect the facts that show these laws in operation. But so well have the relevant laws been marshalled, with a sufficiency of the facts, that the case does not rest on any argumentative ingenuity. The conclusions do not even have to be formulated. The laws and facts speak for themselves. . . .

Here Mr. Pollen discusses at length the fundamental distinctions between flight and other methods of locomotion, instancing experience with aircraft in the War. He continues :—

The Master Puzzle.

And so one finds oneself faced with the master puzzle: How are we to explain the fact that an impoverished nation, crippled by debt, industrial disputes, and unemployment, can afford to spend over twenty millions a year on an activity the proved practical value of which is so very small? What has led us into spending on so uncertain a luxury half what a few years ago we spent on the Navy? What keeps us at this spacious spending now? The official pronouncements do not really help us—for when they are specific they are contradictory, and when they are not, they are without meaning at all. I have ventured on the suggestion that the bright young conjurors of Kingsway have been over-calling their hands, and, as is the case of those who have this disconcerting habit at the card table, this over-calling has followed no principle. The successive callings have, indeed, been apt to be mutually destructive. At any rate, what is said by those to whom the young enthusiasts supply matter for their speeches, leads one so to think. There is an airy

* "The Great Delusion." By "Neon." With a Preface by Arthur Hungerford Pollen. (Ernest Benn Ltd. 12*s.* 6*d.*)

inconsistency about the advocates of a large air policy, when they are out to prove its coming supremacy in peace or war, so startling and so persistent as to make one wonder, if the metaphor may be used, whether they have not missed their mark and are all at sea? It would, of course, be absurd to hold the Prime Minister, Sir Samuel Hoare, Marshal Trenchard, Lord Thomson, or Sir Sefton Brancker personally responsible for the technical accuracy of their statements. If they are to be criticized let it be for their strange hesitation in perceiving that the experts do not all, or any one of them always, tell the same story.

Contradictory Statements.

For example, we have Mr. Baldwin saying that our Air Force must be equal to protecting this country from the attack of any air force maintained by a neighbour within reach. At first sight this looks quite a plausible standard by which to measure our proper strength in men and machines. It is the answer that any Cabinet Minister would give, knowing that he was on safe ground. But then in flying nothing is safe—least of all the ground. And so we next have Marshal Trenchard who, with the directness of the bluff plain soldier, knocks the bottom out of the Prime Minister's case. He implies that to defend this country from other air forces is just the one thing which the Royal Air Force cannot do at all! In this, Marshal Trenchard was following a notable precedent. Mr. Churchill, it will be remembered, at the outbreak of war cheerfully informed the War Office that it must not look to the British Navy to safeguard the shores of England. The military *raison d'etre* of our Air Force seems on this a one to be anything but clear to those responsible for national defence.

Now take the case of airships. It has been suggested that these are to have a considerable war value, while the expectations of their imperial services have been put pretty high. A suggestion, welcomed with enthusiasm by successive Governments, is thrown out that the Ministry and a private company should co-operate to produce two five-million cubic foot machines to link the Empire together, so that the farther point, New Zealand, shall not be more than fourteen days away from London. This involves crossing all the tropics that there are, and at a point—the neighbourhood of Java—where thunderstorms are not the exception, but the rule. Of the behaviour of airships in the tropics—that is, their conduct other than when struck by lightning—no one in the world, Sir Sefton Brancker says, knows anything at all. What more reasonable than that one of our post-war airships—one that had been completed, but hardly yet flown—should be fitted out, sent to Egypt, and used to collect the data so totally wanting and so vitally necessary, before this great adventure of Empire linking can prudently be undertaken? The order is given, much money is spent. We are, you see, to proceed on scientific and commonsense lines. But within ten days of an official pronouncement that this experimental flight is essential, it is incontinently cancelled. The unknown data, we are told, might indeed be useful. But why bother about a little thing like that? We will assume that it will be all right "on the night." And after all, what is our Research Department for, if it leaves us, like King Canute, powerless to order the rising tide to fall? So the building of the great craft goes on; the Dominions' Premiers are invited to inspect the plans; we have columns about the provision of comfortable sleeping quarters and dining and smoking saloons for one hundred passengers—just as if everyone did not know that the proposed ship cannot even theoretically carry the proposed weight; that it is simply madness to send one loaded across the tropics with pilots ignorant of all the elements that made other navigation safe; and that to pass through the thunder belt with the ship unprotected from instant combustion is more akin to suicide than mere folly.

No Commercial Future.

Now take the case of Sir Alan Cobham. The Minister for Air, inspired no doubt by the adepts of Adastral House, said his performance was conclusive of one point, long in debate. It was the harbinger of a commercial conquest of the world by aeroplane! And not only that, it ensured the Air Ministry being the chief focus of travel and transport in the future! What a prospect! But this was too much for the truthful Sir Alan. There was, he told us, no possible commercial future for the aeroplane at all. The value of his flight was that it proved the plane to be militarily supreme! Just that, and nothing more. The commercial air triumph was reserved for the airship. Now note a curiosity. Sir Alan is a really great exponent of civil—but not profitable—aviation. He is not of the R.A.F.; he is not an airship expert. His faith, therefore, in the fighting future of the air and in the trading future of the airship is unshaken in either case by practical knowledge. But he does know all about aeroplanes as a means of transport and travel, and he can be trusted when he says that there is simply nothing in it.

Similar contradictions abound in Neon's collection

of evidence. Indeed, the strange thing is that in this indictment, compacted of evidence that can hardly be shaken, there is scarcely a single quotation from one who is hostile to the purpose for which the Air Ministry exists. If the propagandists are condemned, it is out of their own mouths. It is they who have created this chaos of conflicting opinion.

It is, of course, a symptom, and the disease can readily be diagnosed. There is no doctrine behind our air policy, or rather, as each untoward thing happens, a new theory has to be produced. When R.33 was just saved from ruin by a lucky shift of wind, the crew were congratulated by Sir Samuel Hoare for having saved the future of airships by this most fortunate escape. Another wreck and the whole business would have been done for! Does our policy really rest upon so frail a hazard as this? Does it mean that there is no policy because there can be none? Are our spokesmen subconsciously aware that the present limitations of the airship and the aeroplane as vehicles are fatal to their playing a great part in peace or war—and so must either find new arguments to meet new cases, or get rid of the limitations?

The Aeroplane in War.

Fortunately, or unfortunately, there is however one capacity of the aeroplane which is not in dispute, and on this some advocates of its military value have fastened. It seems to be the only thing on which, most lamentably, all the experts are agreed. It has accordingly become the corner-stone of our military policy. There is nothing vague or tentative about it. The plan is naked; and hideously unashamed. The singular mobility of the aeroplane is to be put—if the solecism may be excused—to a still more singular use. Our enemy's undefended towns and villages are to be bombed; the non-combatants coerced into calling off the combatants. We, of all nations, that is, have come to this. We are to put our faith in frightfulness. Were this our real creed, surely better means are at hand. The long-range guns of the Navy could flatten out more towns, and kill and maim more women and children in a one-day's coast-wise cruise, than all the squadrons we are ever likely to possess could manage in all the flights they could ever make. The education of naval officers, it is true, would need a few modifications before such tasks could be counted on as congenial. But are not airmen Englishmen too? Let us examine this proposal a little more closely.

I have already asked the question whether, rightly looked at, the theory that there could be a war in the air did not arise out of the succession of sky combats, that thrilled us from the beginning of the immobility of the armed forces until freedom was restored. That was, indeed, not only a kind of air war, but a war that had the knightly note. It was a war of single combats, to which champion challenged champion. These combats had the mark of chivalry. The sheer bravery and skill of the thing brought back to a war already disfigured by a hundred lapses into barbarism, those momentary detachments from mutual hatred on which the epic poets and the chroniclers love to dwell. It was not the peaceful public only, it was the armies that stood still, gazing till the issue was known. If all this was diversion, it was a magnificent diversion. It restored some respect for an enemy not otherwise worthy of respect. But it was not war. The aces fought and fell. But there was no panic when they fell. The deaths of Goliath and Hector were great military disasters. In losing them, their fellows lost half their strength. We might lament our heroes of the air, but we knew that their survival or their perishing could not affect the final decision.

But there was another air war that went on the while. It was not chivalrous. It was not magnificent. It also was not war. It was no more war than were the unwarned sinkings by submarines, "leaving no trace"; than the battle-cruiser raids on the East Coast towns, and the aeroplane and Zeppelin raids on London and Hull. These, like the air fights over the lines, grew out of the immobility of the enemy's sea fighting forces. But there is nothing epic about indiscriminately slaughtering non-combatants. Nothing, that is, except the stoic courage of the survivors, the *saeva indignatio* that made first the nation attacked, and finally all the world, sternly resolute that, cost what it might, the foul thing that caused these things must be ended once and for all. Have we forgotten all this?

Methods of Barbarism.

There are certain things to be borne in mind about methods of barbarism in war. To begin with, there is nothing modern about them. They do not embody any new military principle. They are not examples of any logical extension of the science of applied force. Indeed, it is their abandonment that is modern. And they have been abandoned, partly from a common feeling that they are revolting, but more because this feeling is backed by right sense. Hence, our own anger with the baby-killers was far from being our only reaction against frightfulness when we were its victims. For we had learnt something from our

long championship of the rights of sea power, and our long apprenticeship to its duties. For two centuries and a half we had maintained the principle that war at sea could be conducted on ordered lines, and we had, indeed, so conducted it. Only the armed ships of the enemy could be attacked, and only armed combatants killed. The lives of non-combatants, enemy as well as neutral, were ever sacrosanct. If their property was forfeit, it was only when such property was destined for the enemy's comfort or support. Our methods on land did not conform to our sea standard until a century ago. But we set a good example then. Wellington was, I believe, the first European commander to pay for every requisition from the civil population, whether nominally friendly or professedly hostile, and the first to punish by death the man who stole a hen or assaulted a woman. We are not to suppose that the Iron Duke had men enough to spare for mere vindications of good morals. He acted ruthlessly, because in defence of a vital military principle, simple and obvious enough to us now, but not so clear then. He saw, first, that licence and cruelty would wreck the discipline that makes good soldiers; next, that atrocities would rob him of a sympathy the value of which might, at any moment, be incalculable. And he saved the Paris bridges and Napoleon's Arch of Triumph from Blücher, not because he loved the French, or thought the monuments too pretty to spoil, but because, when the fighting was over, he wanted the war to be ended altogether. He would have no unforgivable acts of vandalism spoil the peace, any more than he would have useless and rankling cruelties spoil the war.

True Military Argument.

More exactly stated, the true military argument against attacking non-combatants is this. The issue of war is decided when the armed forces of one side are destroyed or paralysed by the armed forces of the other. The first of military maxims is to concentrate on securing this ultimate victory. The reader will remember the dispute between the Westerners and the Easterners in the recent war. The case against sending so large a force to Palestine was that it weakened the force in France, where alone, it was said, victory could and therefore should be sought. The Palestine adventure, the arguments ran, involved dispersion—that is, waste—of power. I am not concerned to suggest which side had the best of it. But unquestionably it is the fallacy of force misused that condemns attacks on non-combatants. No country's resources are limitless. If you expend your money and your effort on planes—the costliest of munitions—for bombing civilians, you weaken to that extent the pressure you can bring upon the enemy's force. The argument for frightfulness is that you gain more by spreading terror in the nation behind the army than you lose by your resulting weakness in the decisive battle. But in the great European War frightfulness did not have this effect. It had, as we have seen, one diametrically opposite. And as the pages of Neon show, some of us have tried this form of frightfulness since, on the Indian frontier, in Syria, and in Morocco. The results seem to be no better than our masters, the Germans, were able to get. Apart, then, from all other considerations, the thing must be abandoned now as a thrice-proved failure.

Weakness of State Research.

Finally, indeed, looking at all the chaos, all the conflicting dicta here collected, one is left wondering whether the only explanation of it is not to be found in a lurking belief that while the laws of nature, of military science, and of ethics, seem, for the moment, to be set in hostile array against our aerial mania, there is yet a hope that the laws of nature at least may be changed or bent to the Ministry's will, and that any excuse or theory is good enough for keeping things going meantime. Is not this hope, in fact, almost the professed function of the Department of Research?

The struggle between the sound economists and the politicians of all parties turns on a simple truism. Neither all industry, or any industry, can be governmentally run or controlled because industry is the outcome of an immense number of acts of enterprise, not one of which is conceivable when any of the elements which constitute enterprise are wanting. It is these elements that are the main springs of discovery, invention and creation. But these elements do not and cannot exist in any State organization. It is this limitation that marks the chasm between what a Government can and cannot do. It cannot create. It can use the creations of individual enterprise in the public service. . . .

Of all forms of enterprise, that which is the most wholly personal is the gift of suddenly perceiving what is hidden from other men. It is this rare gift that we recognize to be the peculiarity of those pioneers in discovery and invention who are the true authors of modern progress, the great benefactors to whom we owe the immeasurable material advances of the last century. This is fundamental work, and is as individual as genius in poetry, music and painting. It is no more possible for a subsidized body of State

investigators to emulate Newton, Faraday, Watt, or Lister, than for the art schools, the faculties of literature, the conservatoires, or Dartmouth to add a Rembrandt to the National Gallery, a sonnet to Shakespeare's sequence, a prelude or fugue to the immortal Forty-Eight, or a Nelson to the Navy list. If, as I suppose, the true explanation of the babel I have been considering is that the Air Ministry is hanging on until some new force or some new substance is produced by its Research Department, then the answer is obvious. If it is the Almighty's wish that a genius capable of such fabulous wonders is to appear for the greater happiness of mankind, then, and only then, will the hidden secret of air success be revealed. For a Government department to aspire to such providential powers is not mere presumption. It almost looks like demoniac possession.

Neon's achievement, then, seems to me to promise more than the mere clearing of our thoughts on the subject—fascinating because so mysterious—professedly discussed. Our air policy is the offspring of the most astonishing of human inventions. Its snipe-like twists and turns should not surprise us when we remember the magic influences which first fathered and now sustain it. If seeing it for what it is, we see too how it is sustained, may we not have learnt a lesson which will have wider and not less fruitful applications? Is not faith in the Omnipotence of the State, the most general, the greatest, and the most dangerous of all delusions?

Future of Motor Fuels.

In the fifth annual Jesse Boot lecture, delivered at Nottingham last month, Professor F. S. Kipping, F.R.S., dealt with the present and future of motor fuels. After outlining the fermentation processes involved in the production of alcohol from sugar and starch-containing materials, he stated that alcohol was a very valuable motor fuel but too expensive to use alone. The world's annual production of alcohol was said to be 450,000,000 gallons, but of this about 370,000,000 gallons are contained in alcoholic beverages, leaving only 80,000,000 gallons for industrial purposes. Of this a large proportion was required in the making of ether, perfumes, dyes, etc., and very little was left for use as a motor fuel. Alcohol from starch could no doubt be obtained in immensely larger quantities than at present, but its production as a motor fuel from sugar or starch was at present economically impossible. The lecturer concluded by discussing the possibilities which lay in the conversion of the enormous supplies of cellulose (much of it waste material) into alcohol. Cellulose, of course, is the chief component of all vegetable tissues, and is employed in enormous quantities in the form of cotton, jute, etc., to make textiles, and in the state of pulp, chiefly from wood, to make paper. Alcohol might be produced from it either direct by the aid of some organism still to be discovered, or by previous conversion of the cellulose into sugar and then fermenting the sugar.

Excavations at Ur.

[*Royal Air Force photograph—Official Crown Copyright reserved.*

GENERAL VIEW OF THE EXCAVATIONS AT UR OF THE CHALDEES IN MESOPOTAMIA.

This clearly illustrates the remarkable extent of the excavations so far conducted on the site, where work is still in progress under the direction of Mr. Leonard Woolley. The latest discoveries at Ur are described in this month's editorial notes.

The Infinitely Variable Gear.

A New British Invention.

As the result of British research, a solution has been discovered to one of the oldest problems in the transmission of power. For the first time a positive drive infinitely variable gear is available, and its application to many kinds of machinery is now being developed.

A PROBLEM that has baffled inventors ever since the steam engine became a practical proposition more than a century ago, has just recently been solved by British engineers by means of a new apparatus known as the "P.I.V." or positive infinitely variable gear. It is now possible to give an unlimited number of variations in speed to a driven shaft from a driving shaft, at almost any distances between the shafts, with truly positive (non-slipping) transmission, and controlled by a single handle or lever.

Hitherto it has been necessary, for varying speeds, to rely on a belt-drive with conical pulleys on which the belt could be slid backwards and forwards, or variations of this principle, which is, course, non-positive—that is, the belt slips—as are all methods dependent on friction. With the ordinary change-speed gear box, as used on a motor-car, only three or four speeds can be obtained, and it has to operate at short centres, while any ratchet device, apart from other disadvantages, is not indefinitely variable, but simply gives a number of speed changes equivalent to the teeth in the ratchet wheel. With the new infinite gear, however, as the transmission is truly positive like a roller-chain drive or motor-car gear box, an accuracy of speed control hitherto regarded as impossible in all kinds of machinery may be obtained, the field of application being practically every industry for which power is required.

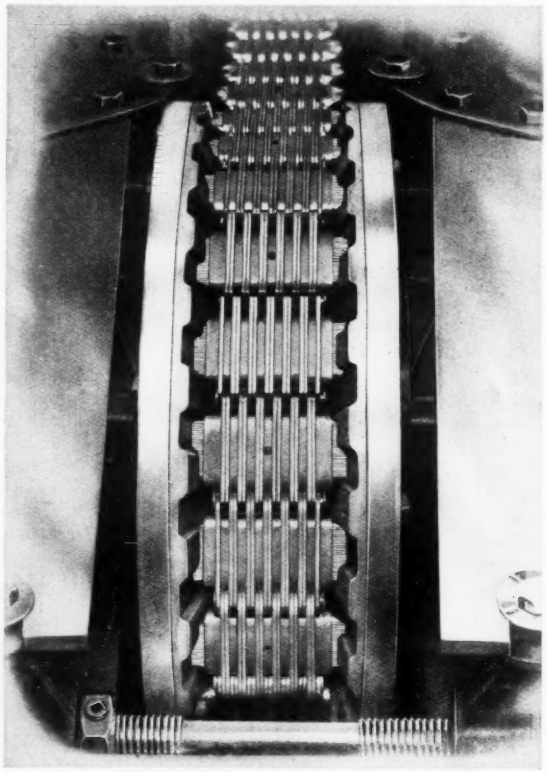


FIG. 1.
CONSTRUCTION OF THE SPECIAL CHAIN.
As the chain travels over the pulley-wheel in the new gear, the thin steel slats seen in each link are pushed across and back by the ribs into the spaces, with the result that it always engages the driving faces at whatever distance apart these are adjusted. When the ribbed faces are opened out, the chain automatically sinks nearer the hub and so travels on a smaller circumference, conversely rising when they are brought closer together.

The essential principle of the new gear is the use of a driving chain of special construction, which in the standard design runs between expanding pulleys of the opposed conical disc type, one set on each shaft, sloping at an angle of 30° in the inner faces to the shaft. These faces have alternate ribs and grooves radiating to the centre, which are broader at the periphery and narrower at the hub, while the two faces are "staggered" so that a rib is always opposite a groove, the chain being engaged at the edges by these ribs which act as teeth, with the result that the drive is positive.

The construction of the "P.I.V." chain is of original character, and is clearly illustrated in Fig. 1. Each link is punched with a longitudinal slot in which is fixed a sleeve or case containing a large number of thin steel slats, loose in the sense that they can move in a direction at right angles to the travel of the chain. These slats project on either side of the chain, and as a link enters the "V" of the pulleys, the requisite number of slats become pushed across by the ribs of one pulley face into the corresponding space between ribs on the other, so that the chain continually engages in all positions with the disc driving wheels.

In order to alter the speed of the driven shaft, it is only necessary to slide the halves of each of the pulleys along the shafts to a very slight extent, this being effected by a common lever or handle as seen

in Fig. 3. On one shaft the two halves are brought closer together, and the chain—which is, of course, always the same width across the slats—therefore rises automatically in the grooves, giving the same effect as a pulley of a larger diameter; while the other pulley, on being correspondingly widened out, causes the chain to sink deeper in the grooves. The whole arrangement can be operated as an open drive at long distances between the driven and driving shafts, or it may be contained in a small enclosed box (Fig. 3) running in oil and quite impervious to dust, heat, or other deleterious influence. The five horse-power unit, for instance, is only 20½ by 13½ by 10 inches in size, while the transmission efficiency as shown by recent tests at the National Physical Laboratory is as high as up to 95 per cent.

If it is only required to vary the driven shaft indefinitely within a comparitively restricted range, the variable pulley faces are fixed on the driving shaft only—in the case of Fig. 2, on the shaft of an electric motor, adjustment being made by the wheel handle seen on the right—though the rim on the driven shaft is similarly ribbed so as to engage the special chain.

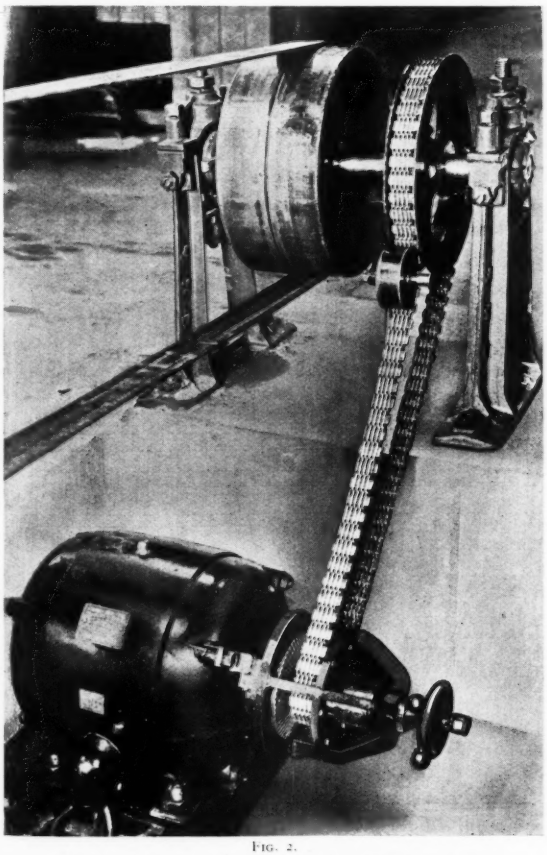


FIG. 2.
THE NEW GEAR APPLIED TO PRINTING MACHINERY

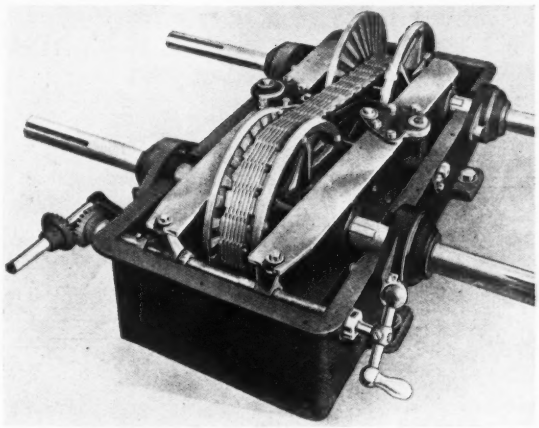


FIG. 3.
P.I.V. GEAR-BOX WITH COVER REMOVED.
The driving engine is connected with one shaft and the machinery to be driven at varying speeds with the other. By turning the handle seen in the right foreground the faces of the near gear-wheel become closed and those of the other opened, the chain adjusting itself to the new circumferences and so causing the shafts to turn at different speeds.

As illustrating the possibilities of the five horse-power gear, the driving shaft at 750 revolutions per minute allows of an infinite number of speeds between the range of 300 and 1,800 revolutions per minute in the driven shaft, while in the case of an open-chain electric drive, the speed of the shaft driven by an alternating-current motor running at 1,000 revolutions can be varied instantly within a range of 250-500 revolutions merely by adjusting a wheel control. In this connexion, an important advance rendered possible by the new invention is that the alternating-current motor can now be used direct for variable speed shaft driving, without the necessity of direct current motors and "transformers" which have hitherto been essential as an alternating-current motor can only be run at one constant speed.

Of still more remarkable application is the special gear box which renders possible a constant automatic variation in speed within any pre-determined range. For example, in one design, intended for the spinning of artificial silk, the driving shaft runs at a constant speed of 300 revolutions per minute, transmitting 3-4 h.p., while the driven shaft, starting at 330 revolutions per minute, gradually falls smoothly and continuously during fifty minutes to 270 revolutions, after which it returns to 330 revolutions again for the short space of four seconds before the whole cycle recommences. This is an entirely new principle and will be of value to many industries. Finally, an infinitely variable gear suitable for motor cycles, is now undergoing tests on the road.

The War-Guilt Question.

By R. B. Mowat,

Fellow of Corpus Christi College, Oxford.

The simultaneous publication of the British and German official documents on the origin of the war has given rise to renewed interest in the vexed question of war-guilt. The single volume of British Foreign Office papers so far issued deals only with the few weeks immediately preceding the 4th August, 1914; the present article is based on research covering the long anterior period.

No good citizen of any country likes to keep alive old controversies. If the Germans would give up writing and speaking about the war-guilt question, their former opponents and present friends would be perfectly content to let the matter rest. There is, however, an unceasing canvassing of this problem in Germany, an unremitting effort to induce the Allies to admit that Germany was not to blame. Upon such an admission would follow a demand for the revision of the Treaty of Versailles, the treaty upon which the present frontiers and international relations of the European states directly or indirectly depend. As the Germans will not let the question rest, it is the duty of every student of European affairs, not with a view to keeping alive old animosities but simply in the interest of the existing peace, to put forth from time to time what on examination he ascertains, so far as he can see, to be the truth.

Latest German Views.

Naturally many monographs have been published in Germany on the question of war-guilt since the Treaty of Versailles was made. Of these books the temperately written work of Count Max Montgelas, "The Case for the Central Powers" ("Leitfaden zur Kriegsschuldfrage") is probably the best known in Entente circles and in the United States. But in addition to monographs which appear from time to time, there is a substantial journal published in Germany, called *Die Kriegsschuldfrage*, and devoted exclusively to war-guilt.

The thing which chiefly rankles with the German people is probably not that they were considered by a majority of peoples to be responsible for the catastrophe of the World War, but that having been defeated by main force they were then (according to their view) by main force compelled to admit moral guilt. This admission is supposed to be contained in article 231 of the Treaty of Versailles. As a matter of fact, article 231 is not primarily concerned with war-guilt but with damages. It says:—

> The Allied and Associated Governments affirm and Germany accepts the responsibility of Germany and her allies for causing all the loss and damage to which the Allied and Associated Governments and their nationals have been subjected as a consequence of the war imposed upon them by the aggression of Germany and her allies.

The part of the treaty to which this article belongs (Part VIII) is headed "Reparation." A treaty imposed upon one side by main force does not and cannot deal with points of conscience; it can and does deal with material liabilities. Part VIII, "Reparation," article 231, therefore merely imposed upon Germany the responsibility (which Germany accepted) of making good the loss and damage which she caused to the Allies by attacking them in 1914. Nobody denies that the Germans were the aggressors in the ordinary sense of the word, that is to say, that they refused a reference of the dispute to the Hague Tribunal, and that they actually first opened operations against Russia, France, and Belgium; the only possible controversy in regard to this is whether the Germans were justified morally in making the first attack. This controversy is not dealt with in article 231, if the article only states an accepted fact and deals with a financial liability.

To say that article 231 does not deal, at any rate not directly, with the question of war-guilt, does not mean that the Allies omitted to make their view clear at the Conference of Paris in 1919. They stated their view and their argument, not in the treaty, but in the famous *Mantelnote* or "covering note," presented to the German delegates at Versailles on 16th June, 1919. This note declared very plainly and with a good deal of argument that the Allies held Germany to be guilty of having deliberately caused the war. But the *Mantelnote* is not part of the treaty, nor were the Germans asked to agree with its arguments. Concerning this note President Wilson made his well-known remark that he was doubtful if it would prove of much use to future historians.

The Roots of the War.

Any thorough examination of the question of war-guilt must deal with two separate periods: one is the famous Twelve Days, immediately preceding the outbreak of hostilities; the other period is that of the anterior years, from 1870 to 1914, the period of

"the roots of the war," as Mr. J. S. Ewart the Canadian investigator of war-guilt calls it. Mr. Ewart writes: "the roots of the war between Principals and among Accessories, although little understood and never adequately discussed, are of infinitely greater importance than are the library-laden debates as to the precipitating causes" ("The Roots and Causes of the War," i, 4).

Count Max Montgelas' book, although written from the point of view that Germany is not to be blamed as having caused the war, is temperately expressed, and in many respects frank. Against the charge that Germany fought the war of 1914 as a "preventive war," that is, a war to destroy her possible enemies before they became too strong, he replies that Germany could have fought, under much more favourable conditions, in the international crises of 1898, 1902, and 1906; even the later crises of 1908, 1911, 1912 and 1913, concerning Bosnia-Herzegovina, Tripoli, and the First and Second Balkan Wars would have been, he thinks, much more favourable to the German strategy than was the crisis of 1914. This argument appears to be justified. The idea of a preventive war does not seem to have influenced the minds of the high authorities either in the Imperial Chancellery or in the General Staff, in the period before 24th June, 1914.

On the other hand Count Montgelas admits that Joseph Chamberlain's great Birmingham speech in 1898 was "almost an appeal for a German alliance." Why then did the German Government turn a deaf ear to this appeal? Not merely did they do so, but as Lord Grey points out in "Twenty-five Years," they quashed the appeal with "a diplomatic snub." Count Montgelas also allows that the deplorable Anglo-German antagonism, which caused so much tense atmosphere in international relations after 1907, was "aggravated by Germany's naval policy." His view is that the German Admiralty's insistence on a big navy, although excusable and intelligible, was politically a mistake. A critic might pertinently ask: Is not the German Government to be held responsible for endorsing the German Admiralty's policy, and for having refused the British offer, made more than once, of a "naval holiday"?

Influence of Big Armaments.

The "war-atmosphere" of Europe, in the fifteen or twenty years before 1914, was largely caused by the big armaments. The first and second Hague Conferences were summoned to deal, among other things, with disarmament. Count Montgelas allows that the German Government acted unfavourably to the project of disarmament, but he holds that the other Powers, on the whole, were not much better inclined. It is true, he points out, that Great Britain insisted on the inclusion of the question of disarmament in the agenda of the second Hague Conference but, he says, Germany and France defeated the project when it came up for discussion. He admits that if Germany had accepted the proposal for disarmament it would have been carried, especially as Great Britain, the United States, and Russia were pledged to it; thus its acceptance, writes Montgelas, "would have secured Germany for ever from French occupation."

The Position of Russia.

A great deal of space is naturally given to a discussion of Russian ambitions, and especially to the remarks and writings of Isvolsky while ambassador at Paris. There is no doubt that the German Government was always very apprehensive of Russia; nor does any historian dispute that Russia cherished an ambition to obtain Constantinople—Russian diplomatists seem frequently to have spoken of their country's "historic mission." But this proves nothing. The German indictment against Russia rests partly upon an alleged Russo-Bulgarian Treaty of Alliance of December, 1909, the genuineness of which has never been proved; the only evidence for it is the revelation of a former Serbian chargé d'affaires. The other thing upon which the indictment rests is a Bolshevist revelation of the minutes of a Russian Ministerial Council of 21st February, 1914. In these minutes Sazonoff, Minister for Foreign Affairs, is reported to have said: "Possession of the Straits cannot be achieved by a localized war against Turkey, but only within the limits of a European war." If Sazonoff said this (as is not improbable) he was only stating a fact; it does not in the least indicate that he tried to bring to pass, or desired, a European war. As for Isvolsky's famous "I made this war" (if he ever said it), it proves nothing at all. It was no doubt flattering to Isvolsky's vanity for him to think that while at the Paris embassy all international relations centred around him. But M. Poincaré shows in his memoirs ("Au Service de la France") that the European statesmen knew that Isvolsky was not wholly reliable; they discounted his statements. His reports, sent to St. Petersburg, of his conversations with M. Poincaré, seem to have contained some grave misrepresentations.

A very well-written and well-documented book is Brandenburg's "Von Bismarck zum Weltkrieg." Like Count Montgelas, he takes pains to show that German diplomacy was exceedingly maladroit in the twenty

years before the war. Indeed, he thinks that it was more than maladroit; it was unwise. Its evil genius was Count von Holstein, who held at the Wilhelmstrasse a position equivalent to that of permanent Under-secretary for the thirty years down to his death in 1909.

So long as Bismarck was at the Wilhelmstrasse there was no irritation to speak of between Germany and Great Britain. There was some ambition among the German people to have colonies, but Bismarck believed that colonial enterprise could only be undertaken if friendship with the greatest colonial power were maintained. If Great Britain were added to Germany's opponents, danger would be "infinitely" increased; and this is what actually happened. The colonial design was pursued by the German Government, in the period after Bismarck (so writes Herr Brandenburg) without any definitely thought-out system; their idea was simply to obtain land where other Powers already had it. This policy produced ever more and more grounds of irritation; and the irritation was made worse by Herr von Holstein's inveterate and continuous "policy of compensation."

"Compensation Diplomacy."

Under von Holstein's direction the German Foreign Office could do nothing and agree to nothing without a *quid pro quo*. This continual and exasperating hunting for compensation is seen, for instance, all through the Morocco question; France was to take no step unless Germany should receive some island in the Pacific or a portion of West Africa. The most successful piece of "compensation diplomacy" was achieved in 1890, just after Bismarck's fall, when in return for German recognition of the British protectorate over Zanzibar, the British Government had to cede Heligoland. During the agitation between the British Government and the Boers, the price of German approval of the British policy was always to be some coaling-station in the Far East (Brandenburg, pp. 64-72). The determination to show Great Britain that German support would have to be bought, and at a substantial price, was apparently the motive behind the celebrated telegram of the Kaiser Wilhelm II to President Kruger at the end of the Jameson Raid. This telegram, as is well known, was not an impulsive *coup* of the Kaiser, but was the result of careful deliberations in the Foreign Office. Herr Brandenburg explains the compensation policy and the "Kruger Dispatch" very carefully. There are also numerous dispatches about the policy in the monumental series of Foreign Office documents published by the German Government, called "Die Grosse Politik der Europaischen Kabinette, 1871-1914."

At first the Triple Alliance gave Germany a fine feeling of security; this for a time made the German Government pursue its compensation policy steadily on every occasion, without caring whether it irritated England or not. The growth of the Entente, however, began to alarm Germany. She tried to detach Russia from France by the abortive Bjorkoe Treaty of 1905. Great Britain, Herr Brandenburg thinks, could have been detached from the Entente by an agreement for the limitation of the German navy; but the German Government feared to weaken this defence (Brandenburg, p. 458). So Germany tried to cover up her alarm by using brave words and displaying her strength—a policy which only increased the international tension. In 1902 Italy had made a treaty of neutrality with France. If Germany did not know this she suspected it. Thus the Triple Alliance could not be depended upon. *Austria remained the last bulwark.* Therefore when the Sarajevo murders occurred and when Austria embarked on a perilous Balkan policy, the German Government felt that it could not afford in any way to estrange Austria, but must give her a free hand and support her at all costs, whether it approved or not (Brandenburg, p. 459).

The present article, necessarily limited in space, deals only with a few of the more important considerations of German historians concerning the period before the Sarajevo murders. For the period after the murders there is a very large, although by no means complete, body of documents, as well as of valuable polemical treatises. For the six weeks, 24th June-4th August, Count Montgelas' work remains an important treatise. The latest addition to the *corpus* of documents is the Volume XI (last in number but first in time) of the British Foreign Office series, which is now being officially published under the editorship of Dr. G. P. Gooch and Dr. Harold Temperley. The volume so far issued deals exclusively with the last six weeks of peace.

Transatlantic Telephony.

WITHIN seven weeks of the inauguration of public wireless telephony between London and New York, the service has been successfully extended to cover not only England, Scotland and Wales, but the whole of the United States. The remarkable progress that this represents may be appreciated from the fact that, area for area, the U.S.A. alone is approximately equivalent to the continent of Europe. Though California is no less than 7,000 miles from London, preliminary calls over this distance are reported to be satisfactory.

Among the Stars : A Monthly Commentary.

THE HEAVENS IN APRIL.

By J. A. Lloyd, F.R.A.S.

THE chart herewith is intended to show the aspect of the principal constellations as seen from London on 1st April at 10 p.m. and on the 30th at 8 p.m., the overhead point being

marked by a cross at the centre. Planets visible this month will be as follows: Venus, will be a conspicuous object in the western sky in the early evening; Mars, setting at 1.15 a.m. at the beginning of the month, is also a fairly bright object and will be seen a little to the left of Aldebaran, which it nearly equals in brightness. Saturn, rising soon after 11 p.m., is visible about midnight in the south-eastern sky. The ring system is now well open, and the planet forms a striking picture in a small telescope. Seen with large instruments it is indescribably magnificent. Meteor observers should look out for "Lyrid" meteors, radiating from a position near Vega, the brightest star in the constellation Lyra, about midnight on or near 21st April. The time employed above is Greenwich mean time, which should be adjusted after 10th April when summer time comes into operation.

Earth's Rotation Problems.

Some interesting problems in relation to the earth's rotation have lately been engaging the attention of astronomers. It has for some time been recognized that the day is slowly lengthening by an almost infinitesimal amount per century, and this is traced to tidal friction in the waters of the earth, especially in narrow seas such as the Bering Sea, the friction of the tides putting a brake on the earth, so to speak. But there are also irregular fluctuations which have more recently been brought to light by a close statistical study of the longitudes of the sun, the moon, and the planet Mercury over a long period. The observed places of these bodies do not always correspond to their predicted places, and these discrepancies are so mutually confirmatory that they seem to leave little doubt as to the nature of the disturbing element. The clock used to time these observations of the celestial bodies is the earth, and the clock would appear to be somewhat erratic in its behaviour. At any rate, this seems at present to be the only reasonable explanation, and astronomers are almost forced to adopt it.

The mathematical astronomer, Prof. E. W. Brown, F.R.S., recently suggested in *Nature* several possible explanations of the earth's fluctuating rate of rotation. He considers that the cause must be looked for in the earth itself, and not in any influence exerted upon it by some external body. The change of rotation must be due to changes in the distribution of the earth's mass with respect to its axis of rotation. If, for instance, we suppose the earth's crust to expand and contract alternately, a temporary increase of the earth's diameter by ten inches would suffice to produce the observed changes. But as it is extremely unlikely, though certainly not impossible, that the crust as a whole can behave in this way, we must fall back on the evidence of local adjustment of mass by seismic disturbances, etc., where large portions of the earth's crust may be suddenly displaced. Apart, however, from the sudden displacements by earthquakes and volcanoes, we must take account of certain quiet processes such as erosion of mountains by rivers and the gradual deposition of sand on the ocean floor. Changes which we cannot see are constantly going on in the oceans, and a quiet raising or lowering of the floor of the ocean might contribute to cause fluctuations in the length of the day. Another possible cause is to be found in the drifting of whole continent masses over the earth's surface as suggested by Wegener some time ago. The melting of ice at the poles may also help to the same end, though probably all these factors contribute their share in the matter. In the meantime, Prof. Brown's paper is well worth reading, as are two papers lately published in the monthly notices of the Royal Astronomical Society, one by Dr. Spencer Jones, H.M. Astronomer at the Cape, on "The Rotation of the Earth," and the other by Dr. J. K. Fotheringham, "Trepidation."

The Spanish Discovery.

The object discovered by Prof. Comas Sola, of Barcelona, and mentioned in these columns in February, now turns out to be not a comet after all, but an asteroid—that is to say, it is one of a vast number of minor planets circling round the sun between the orbits of Mars and Jupiter. Considerably over a thousand of these little bodies are known, but as they are so faint and their motions so perplexing, some of them are constantly getting lost and rediscovered. This latest asteroid moves in an orbit which is greatly inclined to the ecliptic, and is now receding from the sun, so that it is rapidly becoming fainter. A Japanese astronomer, Mr. Oikawa, reports the discovery of a somewhat similar body, having the same daily motion as the Comas Sola asteroid, but rather brighter than the latter.

It seems strange that now the sky is so thoroughly patrolled by large telescopes, night after night, anything of importance should be overlooked. Yet in a new Bulletin (843) of the Harvard College Observatory, Prof. Harlow Shapley calls attention to a large nebula situated in the constellations Centaurus and Musca, near the famous "Coal-Sack," that had been overlooked until quite recently. The nebula is about 2½ degrees in diameter and is of a complicated structure.

The Month's Wireless Developments.

BROADCASTING EYE-WITNESS ACCOUNTS.

By Edward Liveing, M.A.,

Manchester Station Director, B.B.C.

THE regular listener will no doubt have noticed an innovation in British programmes during the last two months. Under the terms of its old licence, the B.B.C. was not in a position to broadcast descriptions of events or ceremonies while they were taking place. The Corporation, however, has been able to take advantage of the new facilities granted to it in this direction. Most of the running commentaries on outside events have so far been confined to descriptions of football matches and sporting events. For some time past, stations of the United States and the Dublin station of the Free State have made a feature of broadcasting sporting events, and the reports of baseball matches in the United States of America have attracted many listeners. The B.B.C. may claim that it has introduced this new feature into its programmes with very considerable success, of which evidence is not wanting in letters from listeners. It is not, of course, proposed to limit these activities simply to sporting events, and the field of programme material now opened up has a wider significance than might at first sight be recognized. There is no doubt that this new side of its work brings broadcasting further still into the position of mirroring human activities. Hitherto the coronation of a king, or the university boat-race, or the opening of a cathedral, could only be conveyed to the listener through the medium of music and other sounds, with the barest linking up of such items by fragmentary announcements. Now it is possible for listeners to hear the fullest possible account of important events, ceremonies and happenings. It is even conceivable that, if there were another war, listeners would be able to hear the progress of a great attack or great battle with a full description by the broadcasting war correspondent, though it is to be hoped that they will hear instead problems which might have led to war discussed in their full entirety in the councils of Geneva. These new facilities will help rapidly to complete the work of broadcasting as an intimate describer of mundane, national, and local affairs.

Wireless and the Press.

Some significant problems are naturally raised. Are these new facilities likely to damage the newspaper press? Who are the right types of persons to secure for these broadcasting narratives? To the first question it is felt that there is no difficulty in giving an answer. The broadcast utterance and the printed word are two entirely different media of expression. Their appeal cannot be the same. Broadcasting, with its appeal to the ear, is more in the nature of a kaleidoscopic review which, when it has done with one matter, passes on to some other item or programme with relentless vigour, but with intense appeal at the moment. The printed word of the newspaper records facts which can be picked up at a reader's leisure and assimilated not once, but many times. I believe that there will never now be a serious conflict between newspaper and broadcasting interests, and that, rather than harming, they will supplement each other's work. Even if we take the most extreme instance, where broadcasting might be considered as being in a position to give news before the newspapers, such as the description of a horse-race with announcements of results, the listeners' reaction will be to buy newspapers in order to supplement their knowledge of an event in which interest has been stimulated.

It is inevitable that broadcasting organizations, whether in the British Isles or elsewhere, will have to try out many different kinds of speakers, both for running commentaries on events and eye-witness accounts given shortly afterwards from the studio of unusual incidents that have been witnessed. No doubt trained journalists with good voices will be considerably employed. In sporting matters a man who has been used to recording such events over the telephone to his newspaper office has an experience which can be relied upon; at the same time, there is an added interest to, say, a football match, if it is described by a well-known exponent of the game. For descriptions of ceremonies, men with imagination and the ability to record vividly their impressions will be needed. Altogether, it may be said that broadcasting is now faced with another problem to solve and a still further technique to develop, and the next few months should witness some very interesting experiments in this new side of the broadcaster's work.

EUROPEAN BROADCASTING DEVELOPMENTS.

CONSIDERABLE interest raised in the doings of German broadcasting has lately been enhanced as the result of the establishment of the high-powered station of Langenberg. But recent progress is by no means confined to Germany, and other countries are showing that they do not intend to lag behind in the development of wireless. In my February notes I mentioned the fact of new decisions of the first importance having been taken by the French authorities with regard to broadcasting, and it is interesting to note that this has been followed up by statements from the Compagnie Francaise de Radiophonie, from which it may be inferred that broadcasting is being reorganized as the result of the new law laid down on 28th December last. An organization entitled "La Radio-diffusion Francaise," which is being founded by the principal wireless interests, has applied to the Ministry of Commerce for authorization to exploit a big national broadcasting station worthy of French culture and technical science. It is also proposed to provide provincial regional stations. The organization includes among its founders the presidents of such literary, artistic and scientific organizations as the Société des Gens de Lettres, La Société des Auteurs Dramatiques, La Société des Auteurs et Compositeurs de musique, La Federation Nationale des Journaux francais, and le Syndicat professionel des Industries Radioelectriques.

Progress in Poland.

From Poland comes the news that more high-powered stations are under contemplation. Already a new high-powered station has been established in Warsaw on the site of what used to be the fort of Mokotow, now a suburb of Greater Warsaw. This new transmitter is about five miles from the "Polskie Radio" studio in the centre of Warsaw. The station has now been opened officially, and serves crystal-set listeners within a radius of one hundred miles. "Polskie Radio" has already built a station in Posen, and is building another at Cracow.

Many of the smaller countries, too, are rapidly developing this new medium of expression.

Book Reviews.

Forest, Steppe, and Tundra: Studies in Animal Environment. By MAUD D. HAVILAND (Mrs. H. H. Brindley) (Cambridge University Press. 12*s.* 6*d.*)

REVIEWED BY SIR ARTHUR SHIPLEY, G.B.E., F.R.S.

Mrs. Brindley has written a notable work. Her accounts of the tropical forests of British Guiana, and of the steppes and tundras of Eastern Europe and Northern Asia, are equally full and vivid; and it is a book that makes you think. There is much original observation in it and much clever reasoning. Animals, she tells us

> are generally intensely conservative in the selection of breeding environment, a fact which the experienced collector unconsciously recognizes when he makes a "find" and offers no other explanation than that "it looked a likely place." Long practice has taught him to appreciate the complex of factors which influenced the animal's choice; for it must not be forgotten that the higher animal possesses the power of *choice* while the higher plant has *opportunity* only in the selection of its environment.

As a general rule, the breeding environment of the individual appears to approach closely to the ancestral environment of the species, and difference of breeding grounds in allied forms is sometimes accompanied by significant differences of appearance or habits.

The field Mrs. Brindley attempts to cover is immense, and not for one moment does she pretend she has more than scratched the surface; but at the same time she has successfully attempted to study those features which dominate the living activities of animals and plants. She deals with soil and its origins, the configuration of the country, mountains and plains, dry areas and marsh, the course of the rivers, forestry, the kind of vegetation. Then, again, the study of climate is most important. Temperature and rainfall with their annual and monthly minima and maxima and the daily rise and fall should be considered. The character of the rain is also important: Does the water come down as a tropical torrent, or is it the kind which "droppeth as the gentle dew from heaven" in a soft, penetrating drizzle? Then, again, we must study the distribution and life-history of the species under observation. We ought to know the duration of embryonic life and of post-embryonic growth, and the duration of adult life. Further, physiology and biochemistry come into play. As far as possible we want to search out the physiological reactions of the animal, the physical factors of its environment. Finally, the student must be well acquainted with systematic zoology; it may seem a dry subject, but it is the foundation of the science.

Some very interesting paragraphs are devoted to fluctuations which periodically occur in certain animals. Every eight or six years the lynx which preys on the American rabbit shows a maximum which tends to occur either in the years of the rabbit's increase or a little later. Fur-bearing animals, which live on the small rodents, are so common during the time of the greatest increase of the latter that they attain their food with no difficulty and the trappers have a bad year. Now Elton has recently published an interesting theory to account for these periodical increases. He observes that the same species may increase at the same time in different parts of the world, which suggests some far-reaching climatic factor. He is tempted to associate this increase in certain species with the sunspots, which have an average of about eleven years. When the sunspots are least the temperature of the earth is 0.6° C. greater than when they are at their maximum. Elton attempts to show that increases in the number of different animals take place on an average of about ten years, and that these increasse correspond with the sunspot minima. However, all this, as the local auctioneers say when they are selling "old masters" in a country town, is "very speculative."

The following is a description of a storm in a tropical forest:—

> The force of the downpour is another factor in the oecology of the forest. In the wet season thunderstorms of great violence are frequent, and the rain descends with a suddenness and volume unknown outside the tropics. The sun is shining, the forest glitters with a million lights, birds are on the move, and insects hum and dance from leaf to leaf. All at once a shadow is drawn over the sun, and all activity of bird and beast ceases as the sound of rushing rain rapidly approaches. An avalanche of water then crashes down, blotting out surrounding objects and, as it seems, sweeping the very breath from the nostrils, bewildering and benumbing the senses. Every twig and leaf is bent and battered, and in a few seconds streams pour down the paths and the world seems changed into a thundering cataract. Then, as suddenly as it came, the storm passes, and the sun blazes out again before the roar of the storm sweeping over the tree-tops has died away in the distance. Even before the leaves have ceased to drip, or the land-crabs, tempted forth by the teeming water, have scuttled to covert again, the life of the forest is resumed. It is almost incredible how some fragile forms escape destruction under such terrific bombardments; and yet great butterflies, with a wing span of four or five inches and so delicate that the least touch marks them, emerge from the deluge unblemished. Nevertheless, certain adaptations have arisen to meet these conditions. Some of the inhabitants of the "reservoir" plants are provided with suckers which enable them to cling to the leaves when their home is brimming over. Belt remarks that many forest birds—trogons, motmots, parrots, and toucans—breed in holes in trees, and he supposes that this offers some protection from marauding ants; but it is equally possible that in such situations the eggs and young are sheltered from rain. Occasionally these storms are accompanied by wind, which passes as quickly as it rises, and sends a volley of dead branches, ants' nests, and fruit, hurtling to the forest floor; but on the whole wind is not a factor of great oecological importance in the rain-forest, and the winds of the coastal regions at any rate are regular and steady, rising and falling at particular hours each day. In the early morning especially, it is often so still in the depths of the forest that a photographic plate can be exposed for an hour at a time without fear of a leaf stirring to mar the picture. Rodway remarks that there are hardly any wind-fertilized trees in the forests of Guiana.

The present writer can confirm the description given of the appearance of the primeval jungle from a boat on one of the great rivers. On either side the banks are veiled by a wall of foliage one to two hundred feet high, here and there broken by a patch of coloured blossoms. The profusion of flowering climbers which often hide the outline of the trees themselves is characteristic of the South American forest. The sun hardly penetrates through this living canopy. But at times a shaft of light breaks through and when it falls upon the earth all the insects, spiders and other inhabitants scuttle away from the spot it falls on to avoid the intolerable heat.

Mrs. Brindley travelled extensively in Siberia before the war, and when on war duty in the Balkans had a further opportunity of investigating the great steppes of Southern Russia and Bessarabia. The immensity of the horizon unbroken by mountains, trees, or buildings, is one of the most impressive features of these regions where the bitterly cold winter about which Ovid wrote from the Danube steppe, is suddenly replaced by a short and warm summer, when the flowers seem absolutely to spring from the earth in a night. Here the paucity of species is striking, and the number of specimens is small. The weaklings are killed off by deficient food supply and by the frigid conditions of winter.

The book is packed with information and records of observation. It is provided with ample bibliographies, and the

index is on the whole fair, though it does not do justice to the wealth of matter in the text. The illustrations are so good that they only make one wish for more. Altogether, as we have said, a very notable book.

A. E. S.

Holism and Evolution. By GENERAL THE RIGHT HON. J. C. SMUTS. (Macmillan & Co. 18*s*.).

REVIEWED BY DR. F. H. A. MARSHALL, SC D., F.R.S.

The author of this book has sought to give what almost amounts to a new interpretation of the known universe. In common with many recent thinkers he finds that the conceptions and categories of natural science are inadequate, not only for accounting for the fundamental unity which he believes to underlie all phenomena, but for the purposes for which they were intended. As evidence of this contention he points to the quantum theory and the new concepts of space and time, which in the modern system of relativity are taking the place of the old Newtonian principles. He remarks that the old view of matter as inert and passive has disappeared completely, and with it has gone the concept of the fixity of the atom. General Smuts is scarcely less impressed with the change which he discerns in the attitude of some biologists, and in particular those who maintain that physiology imperatively demands new categories of explanation, being no longer satisfied with the current mechanistic hypotheses which are still commonly held sufficient for the interpretation of the phenomena of life. But the author is not content with the recognition of a change of attitude on the part of scientific men, neither does his work consist mainly of a criticism of scientific theory. On the other hand, the book is definitely constructive, for in addition to the newer scientific concepts he proposes another which on his view is more fundamental than all. To this concept he gives the name " holism " (from ὅλος, *holos* = whole), which he defines as the essential factor operative towards the creation of wholes in the universe. Throughout all nature he discerns a tendency to evolve larger and more perfect wholes. In the process of holistic evolution we pass from mere physical mixtures (where the structure is almost negligible and the parts preserve their separate characters) to chemical compounds (which have a more synthetic structure), and on to organisms (in which a more intense synthesis has been effected, bringing about a unified character and system of co ordinated control and regulation of all the parts), and thence to minds (in which the central control acquires consciousness and a far-reaching creative power), and finally to personality (which is the highest or most developed whole among the structures of the universe and an originative centre of reality). It is characteristic of every whole that it is not simply constituted by the sum of its parts ; it is something in addition.

The author's conception of the whole in biology is not dissimilar to the idea of the individual as developed by Mr. E. S. Russell and certain other men of science. For the individual is something which is self-consistent and self-contained and it is more than the sum of its parts. Moreover, General Smuts' theory bears a noteworthy resemblance to the principle of " emergent evolution " constructed by Professor Lloyd Morgan, for like that principle it stresses the creation of new bodies or structures as a result of the union or development of such as were already in existence. (A simple case of " emergent evolution " is where two chemical elements such as hydrogen and oxygen combine together to form a compound such as water, the properties of which could not have been predicted from a study of the constituents.) The two views have a different origin and were developed independently, and Professor Lloyd Morgan's theory does not recognize the tendency to form wholes, ever more intensive and effective, and which General Smuts regards as basic to the universe, emergence or creativeness being but one feature.

The book traverses a wide field and is original and suggestive throughout, but as is to be expected of a work of such character it is not above criticism. To the man of science the style and treatment may at times seem dogmatic, and the theory makes its appeal not so much upon direct evidence, for this from the nature of the case is often wholly lacking, but to the synthetic desires of the reader who will accept it in so far as he finds it satisfying to his intuitive perceptions. It may be said, however, that the whole idea underlying the treatise is worked out consistently and with a multiplicity of applications, and that the author shows a wide knowledge of the progressive developments of latter-day science.

There are one or two special criticisms which may be made before concluding this brief notice. In dealing with the laws of thermodynamics the author refers to the well-known supposed difficulties involved by the apparent power of the living organism to deflect energy in a new direction without either creating or destroying it. He does not appear to realize fully that the difficulties do not arise if it be borne in mind that the laws of thermodynamics are purely physical laws and fully adequate for the interpretation of the phenomena to which they are applied. They were never intended to explain the processes which go on in the living organism, for the study of which concepts of a different order may very well have to be employed. As General Smuts himself subsequently says, " the laws of life and mind are not in conflict with the laws of energy," yet " an organism is more than a physical structure, but in so far as it is a physical structure it obeys the laws of energy."

The final chapters of the book seem to show a misunderstanding as to the domain of natural science. The author suggests that the study of human personality will in the future constitute a very important science. Here it should be pointed out that there can be no science of the individual, because science deals not with units but with numbers, to which it seeks to apply general laws. Science is limited in scope, and its principles relate to phenomena in bulk and which can in some way or other be measured and dealt with in the aggregate. The holistic principle, as we understand it, does not lead to such being done, and though we may study human personality with interest and profit, our work in this field can form no part of natural science.

F. H. A. M.

Coal, and the Coalfields in Wales. By F. J. NORTH, D.Sc., F.G.S. (National Museum of Wales. 1*s*.).

This booklet contains an account, in simple language, of the nature and origin of coal and the conditions under which it was formed, followed by a description of the Welsh coalfields and the varieties of coal which they yield. In a chapter on conditions which brought the coal-forming period to a close, there is a description of the fossil tree trunk recently found in coal measures at Treharris, of which the author gave an account some months ago in *Discovery*. In this connexion a diagram is reproduced from the journal, while other illustrations also appeared originally in its pages. Modern work upon the micro-structure and chemical composition of coal is also discussed in relation to the industrial use of coal.

Stone Decay and its Prevention. By J. E. MARSH. (Oxford: Basil Blackwell. 3*s.* 6*d.*).

Every architect who designs a building for a modern industrial city must give considerable thought to the life of stone facings or carved stonework. A walk down the Strand in London, Deansgate in Manchester, or Lord Street, Liverpool, brings home the fact that the ravages of rain and smoke are really appalling, especially where ornamental stonework is concerned. Carved enrichment on door and window architraves, on cornices, and so forth, rapidly becomes "blind" after a short period; and on occasions when a building is renovated, and its surface cleaned and repointed, it appears utterly different in character to those who did not know it when it was new. Mr. J. E. Marsh's little book entitled "Stone Decay and its Prevention" is a lucid contribution to an important branch of architectural knowledge. We are told in the preface that in 1861 a Commission appointed to stop the decay in the stonework of Westminster Palace decided to wait for the discovery of a remedy, and with considerable optimism did not appear to think that they would have long to wait. The world is still waiting. Mr. Marsh's introductory survey of the problem deals with the reports of various Parliamentary Commissions, and then follow four sections concerned respectively with "Air, Rain, and Smoke"; "Soil and Stone"; "Theories of Stone Decay"; and "The Treatment." As the author points out, no new specific remedy is proposed. All that is recommended is that the walls of a building should be kept clean, thereby preventing the surfaces from becoming nests for living organisms, for attention is directed to the corrosive effects of minute forms of life on various kinds of stone. Although the algae, lichens and mosses on surfaces are comparatively unharmful, it has been discovered that the hyphae can penetrate stone to the depth of one millimetre. It is pointed out that lichens must also remove mineral matter from stone in order to get the salts necessary for their life. Cleanliness is the only remedy, and in cities where archaic methods of heating predominate this implies appallingly heavy upkeep costs for buildings.

JOHN GLOAG.

On Music's Borders. By SIR RICHARD TERRY. (T. Fisher Unwin Ltd. 15*s.*).

The world of music and musicians is re-forming itself, and it is good to be alive in such a period. With a people like ours, enjoying an all but free education and possessing unlimited opportunities of enlightenment, it seems an anachronism that the Pierian springs should still be guarded by an oracular priesthood, to be filtered through their mystic jargon of words till most of their fragrant freshness is reduced to jejunity. In its general aspect, music more than any other of the arts might surely be claimed in his own right as the heritage of every man. Although the forty-five chapters of this amiable book—for Sir Richard Terry has had opportunity and time to cultivate a graceful pen, often dipped in caustic it is true—cover many phases of our musical life, ranging from ecclesiastical music to jazz, and including opera in England, "consecutive fifths," and "the dismal science of Counterpoint," the author from his vantage ground on the circle of his subject is found, in the course of these varied topics, frequently concentrating on the one problem which is involved in the elimination of music from the national life and its confinement to an exclusive and relatively small class called "musical." All the activities associated with music of which we are so justly proud only affect a part of the nation.

The average British citizen who reacts to every new phase of literature is left comparatively untouched by new phases of music. The public is largely still under the spell of the old traditions, and overawed by labels. "Before you can get *en rapport* with the average British citizen on the subject of music, there is no end of traditional lumber to be cleared away." Having written this Sir Richard Terry sets himself to work with the broom and barrow. "Bogeys" and "The Divorce of Music and Letters" are the titles of chapters in which the author, after the manner of Aristotle, who held that "the duty of a critic is to criticise," declares a ban on the musty verbiage and the deluding pretensions of pedagogic musical practitioners. Very few, even of our modern critics, fulfil the whole function of criticism, which to the writer's mind comprises more than the creation of little works of art of their own and the destruction of the works of others.

The author's reference to the influence on musical appreciation of the application of science and invention to music-producing or transmitting instruments, which have given us the piano-player, the gramophone, and the "wireless," will not be out of place in a journal such as *Discovery*. Has anyone, he asks, noticed the vast space taken up by broadcasting notices and notes? And, if so, have they realized the revolution that it indicates? Thousands of those who used to attend concerts now "listen-in" at home. Has anyone noticed that with the multiplication of gramophones, piano-players and broadcasting stations, fewer and fewer people buy music to play at home on the ancestral piano? They can hear it played better (or sung) by mechanical means. These things are stated by Sir Richard Terry, who, however, carefully avoids an expression of definite opinion whether this "revolution" is for musical good or ill. Yet, in an earlier chapter he spoke of the effect of the post-war economic conditions, and the posibilities of us becoming "less a nation of music listeners and more a nation of music makers." The advent of the thermionic tube, or the familiar "valve" of the wireless installation, may have added something to the science and practice of listening but, at the risk of raising a controversial point, it may be suggested that increasing recourse to "mechanical music" is scarcely likely to enhance music making as a personal human exercise, or assist us to "again become a nation of music makers" (p. 154).

H. H. W.

History of England. By DAVID SOMERVELL. "Benn's Sixpenny Library." (Ernest Benn. 6*d.*).

If the volumes that are to follow this "History of England," the first title in Benn's Sixpenny Library, even approach the standard of excellence which it sets, the series will be a remarkable achievement. The history of a great nation, well and truly told, should be, according to Mr. Somervell, about the best story in the world. It is not too great a compliment to say that he has told the history of our great nation well and truly.

His book will be of great value to every type of reader. For instance, a visitor from Mars, after reading it, would have a sound elementary knowledge of the whole sweep of our history from the Ice Age to the present day. And on the other hand, the well-informed student, replete with detailed knowledge, could not round off his studies better than by reading this masterly generalization. And yet, in generalizing, Mr. Somervell gives enough detail to challenge attention. Nor has he avoided comment, as this quotation will prove: ". . . the Britons . . . were esteemed the most timid of the barbarians . . . now they are the most war-like of peoples. . . ." Such was

Edward III's achievement—an achievement which only a philosopher will entirely despise and only a schoolboy unreservedly applaud. But there are always more schoolboys than philosophers in the world." A passage of particular interest to students of Anglo-American relations gives an original and controversial opinion of the rights and wrongs of the American War of Independence. Finally a word of praise is due to the publishers for the excellent typography which they have used.

E. G.

Wild Birds in City Parks: Being hints on identifying two hundred and three birds, prepared primarily for the Spring Migration on Lincoln Park, Chicago, but adapted to other localities in north-eastern United States and Canada. By H. E. and A. H. WALTER. 12th Edition. (Macmillan & Co. 6*s.* 6*d.*).

As a guide this book will only be of use to observers in Canada and the north-eastern United States, to which its scope is restricted. But it forms a most interesting example of how much can be done to simplify identification by an elaborate system of keys—in England we have nothing so practical and so compact ourselves. Every distinguishing feature—of plumage, habitat, shape, size, or motions—is exhaustively analysed, so that if you only know that your bird was black-and-white with a long tail you would infallibly trace it under those two features and the size as a magpie. Or rather you would not trace it as a magpie directly, but as number so-and-so, for the authors do not escape the tendency of their kind to overdo the variety of simplifying devices and so become complicated, with keys to their own keys and cryptic abbreviations which take some time to master. The authorities for scientific names ought to have been given, especially since the American nomenclature differs so much from the European. No one would guess, for instance, that the chickadee is conspecific with our own willow-tit, when it is given as *Penthestes a. atricapillus*, with no authority. The price at first glance seems rather excessive for so diminutive a book, but if an author compresses in this way enough information to fill a very much larger book, presumably he has the right to receive as much as if he had not expended his energy in relieving us of bulging pockets.

E. M. NICHOLSON.

The House-Fly: Its Life-history, Importance as a Disease Carrier, and Practical Measures for its Suppression. By MAJOR E. E. AUSTEN, D.S.O. British Museum (Natural History) Economic Series.

In his second edition of "The house-fly" issued from the British Museum Major Austen has revised the material and expanded the text. Amongst the new material included in this edition the author, whom we may congratulate on his recent appointment as Head of the Insect Room at the British Museum, has added a section on the insect enemies of the house-fly, and another section dealing with that insect's connexion with animal diseases. He has also added materially to his notes on bionomics and control. Some of the pictures, which are all of value and very well reproduced, have been redrawn. The whole form is most useful as a summary of one of man's worst enemies.

A. E. S.

Books Received

Cape to Cairo. By STELLA COURT TREATT. (Geo. G. Harrap & Co Ltd 21*s.*).

Ultra-Violet Radiation and Actinotherapy. By E. H. RUSSELL and W. K. RUSSELL. (E. & S. Livingstone. 15*s.*).

Journal of the Franklin Institute. February, 1927. (Franklin Institute of the State of Pennsylvania).

Proceedings of the National Laboratory of Physical Research. (National Laboratory of Physical Research. 3*s.* 6*d.*).

American Journal of Sociology. January, 1927. (University of Chicago Press).

Reports and Memoranda. Aeronautical Research Committee. No. 1047. (H.M. Stationery Office. 9*d.*).

Annual Report and Statement of Accounts for year ended 31st December, 1926. The National Institute of Industrial Psychology.

Industrial Fatigue Research Board Report No. 40: "The Effect of Eyestrain on the Output of Linker. in the Hosiery Industry." (H.M. Stationery Office. 1*s.*).

Socrates, or the Emancipation of Mankind. By H. F. CARLILL. (Kegan Paul. 2*s.* 6*d.*).

Photography, its Principles and Applications. By ALFRED WATKINS, F.R.P.S. (Constable & Co. Ltd. 12*s.* 6*d.*).

Atomic Theory. By ARTHUR HAAS, Ph.D. (Constable & Co. Ltd. 18*s.* 6*d.*).

Natural History Magazine. Vol. I. No. 1. (Trustees of British Museum. 1*s.*).

Pheasant Jungles. By WM. BEEBE. (G. P. Putnam's Sons. 12*s.* 6*d.*).

Delphos, the Future of International Language. By E. SYLVIA PANKHURST. (Kegan Paul. 2*s.* 6*d.*).

Journal of the Photomicrographic Society. (Price to non-members 7*s.* 6*d.* per copy).

Journal of the Royal Aeronautical Society. No. 195. Vol. XXXI. March, 1927. (Royal Aeronautical Society. 2*s.* 6*d.* to non-members).

Harvard College Observatory Bulletin 843

Man, a Monthly Record of Anthropological Science. (Royal Anthropological Institute. 2*s.* net).

China Journal. February, 1927. Vol. VI. No. 2. ($1.00).

Annual Report of the Smithsonian Institution. 1925. (Washington, U.S.A.: Government Printing Office).

Elements of Radio Communications. By ELIERY W. STONE. (Chapman & Hall. 10*s.* 6*d.*).

Rainfall Atlas of the British Isles. (Royal Meteorological Society. 15*s.*).

The Mind and its Mechanism. By PAUL BOUSFIELD and W. R. BOUSFIELD. (Kegan Paul. 9*s.*).

Evolution Disproved. By REV. W. A. WILLIAMS, D.D. Published by the Author, Camden, New Jersey. $1.00).

The Solar Eclipse of 1927. Catalogue of Books on Astronomy in the Wigan Public Library. (3*d.*).

Harvard College Observatory Circular 298.

Harvard Reprint 33. "Some Applications of the Ionization Formula." By C. H. PAYNE. (Harvard College Observatory).

Harvard Reprint 34. "On the Spectra of Stars of Class CF8." By C. H. PAYNE

Harvard Reprint 35. "The Apparition Dates of the Andromede (or Bielid) Meteor Swarms." By WILLARD J. FISHER.

Towards the Open. By HENRY CHESTER TRACY. (Chatto & Windus. 12*s.* 6*d.*).

The Philosophy of Individualism: Advance Proof for favour of criticism. (The Individualist Book Shop Ltd. 1*s.*).

Picture Postcards Sets E. 43 and E. 44. (British Museum, Natural History. 1*s.* per set).

A Treatise on Light. By R. A. HOUSTON. (Longmans, Green & Co. Ltd. 12*s.* 6*d.*).

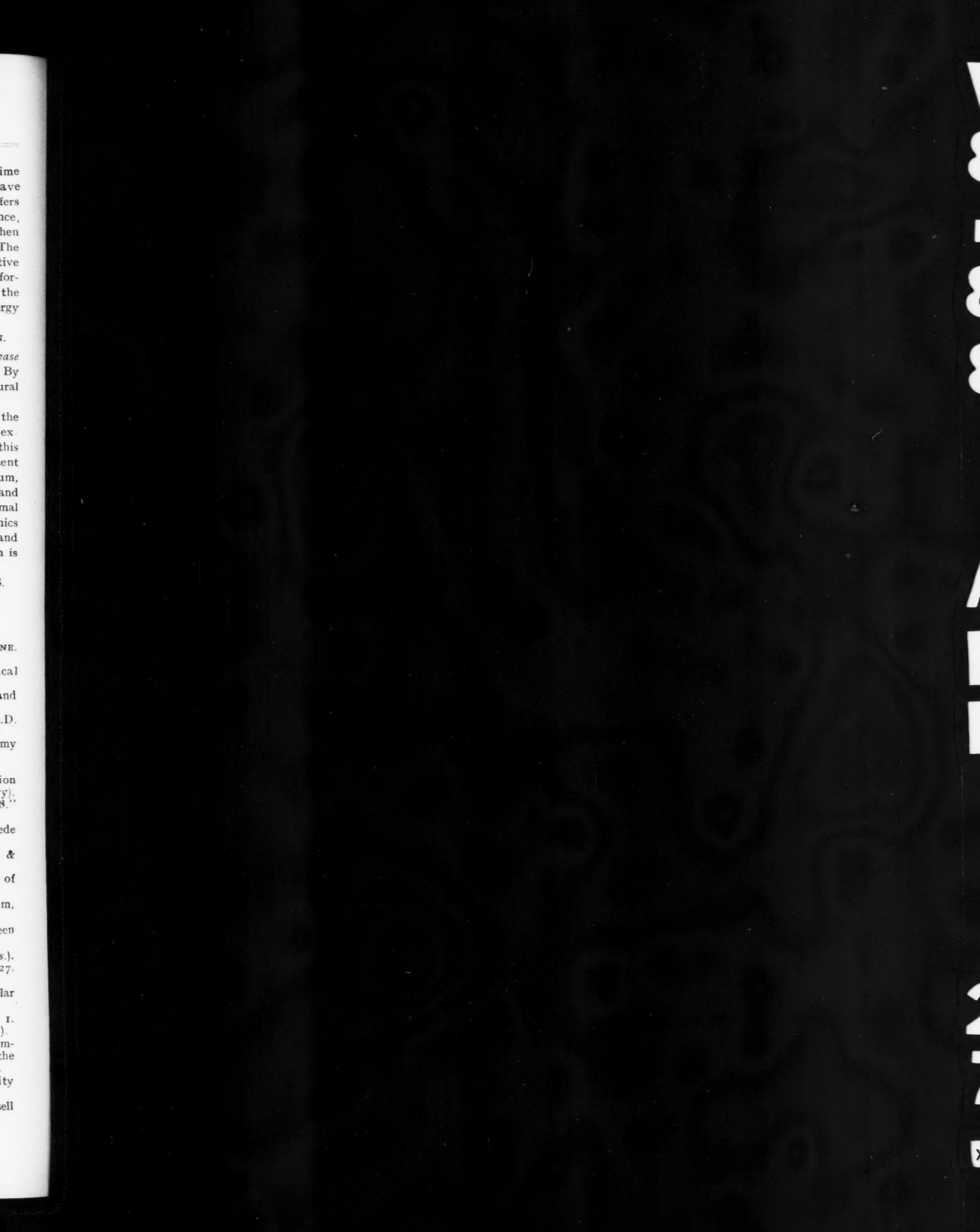
The Caves of Mendip. By H. E. BALCH, F.S.A. (Folk Press Ltd. 2*s.*).

The World's Health. Vol. VIII. No. 3. March, 1927. (League of Red Cross Societies, Paris).

Popular Science. Vol. 110. No. 4. April, 1927. (Popular Science Publishing Co., New York).

Antiquity: A Quarterly Review of Archaeology. Vol. I. No. 1. (John Billows, Gloucester. 5*s.* 6*d.* net., annual sub., 20*s.*).

Biological Monographs and Manuals. Vol. VII: "The Composition and Distribution of the Protozoan Fauna of the Soil." By H. SANDON, M.A. (Oliver & Boyd. 15*s.*).

Psychopathology. By BERNARD HART. (Cambridge University Press. 7*s.* 6*d.*).

The Tomb of Tut-ankh-amen. By HOWARD CARTER. (Cassell & Co. 31*s.* 6*d*).